Editorial

A RECOMMENDATION that FM broadcasting should commence in Australia without delay is contained in the Seventh Annual Report of the Australian Broadcasting Control Board.

The incidence of TV should not be a deterrent, says the report. It suggests that FM stations might be established even before the first TV programs are available.

The reason given is the same as that advanced in previous years, that there is no more room for additional stations on the broadcast band without intolerable interference.

On the VHF bands, where FM stations operate, there is plenty of room.

From a theoretical point of view, it seems logical to make a start on FM if it is the only way out, and more stations are urgently needed. Europe has had them for some time, and BBC programs are to be radiated through a VHF network now being installed.

In America, where broadcast crowding is just as great, FM has not been a success. Many have tried hard and are still trying, but station operators have found it difficult to build an audience.

If all this indicates that FM for broadcasting is inevitable in Australia, it does not mean that the Board's advice to make an early start will raise much enthusiasm.

With the exception that one will provide pictures and the other sound, the problems of starting a TV service and an FM service are much the same. Both are largely self-contained ventures and both require a starting point. Unless someone can be persuaded to stand the financial strain of pioneer work there will be plenty of jibbing at the start.

And while there is so much money invested in Australian TV, the probability of a repeat performance, even on a smaller scale, is most unlikely, particularly as the drain on material sources and manpower caused by TV won't leave much over for FM.

We may have to wait for a Government-financed lead as happened in England, if we are to avoid the lagging response to a purely commercial venture as experienced in the USA.

The Board's further suggestion to hold a public enquiry into the whole question of FM broadcasting would do much to provide firm answers to many of these things.

In the meantime I still believe that our radio industry will largely digest its TV pill before seeking a dose of FM as well.

John Moyle

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RADIO TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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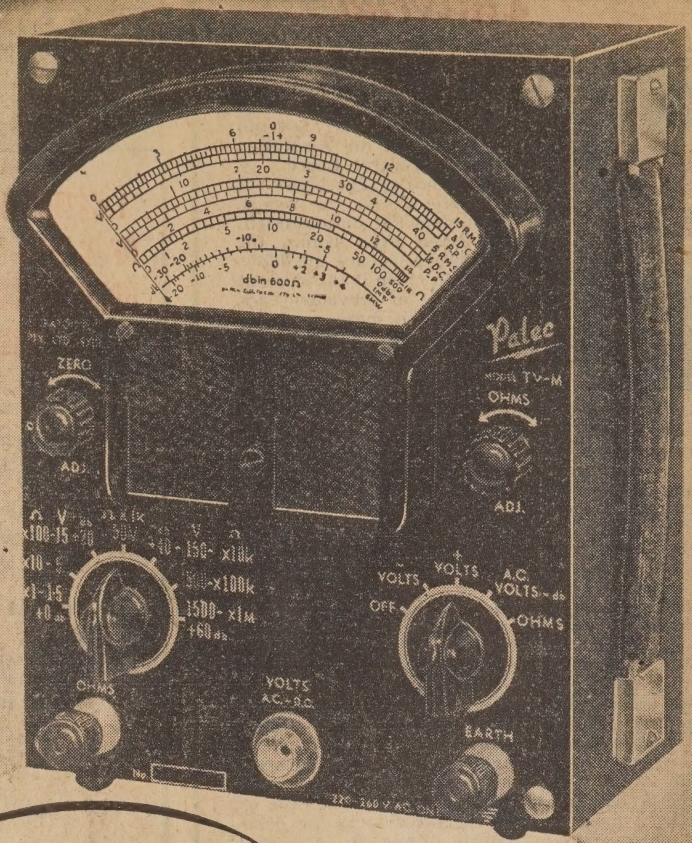
OUR COVER PICTURE

Scientific research against food pests is allowing the world to grow more food. At the Imperial Chemical Labs in England, a scientist uses a special vacuum pump to remove dead aphides which have died after eating chemically-fed bean plants.



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This new "Palec" instrument is destined to become a BASIC NECESSITY in every branch of electronics — NOW and in the television days ahead. A product appropriate to the times, it's performance makes it the most essential and valuable piece of equipment in its field.

SPECIFICATIONS:

	RANGES
D.C. VOLTS—11 Megohm Input Res. 0-1.5, 5, 15, 50, 150, 500 1500	7
D.C. VOLTS—1000 Megohm Input Res. (with H.T. probe) 0-150, 500, 1500, 5000, 15,000, 30,000, Max	6
A.C. VOLTS—R.M.S. Sine Wave. 0-1.5, 5, 15, 50, 150, 500, 1500	7
A.C. VOLTS—Peak to Peak. 0-4.2, 14, 42, 140, 420, 1400, 4200	7
RESISTANCE—(1/4 of an Ohm to 1000 Megohms). 0-1000, 10,000, 100,000, Ohms—1, 10, 100, 1000 Megohms	7
DECIBELS odb = 1mW in 600 Ohms —30/—3, —10/+17, +10/+37, +30/+57	4
DECIBELS odb = 6mW in 600 Ohms. —20/+4, 0/+24, +20/+44 +40/+64	4
Total ranges	42

FREQUENCY RESPONSE 25 cycles to 5 **megacycles.** The Crystal Diode Probe extends the range to **400 megacycles.**

MODEL TV-M. Vacuum Tube Volt-ohmmeter for A.C.-D.C. and Ohms measurements, complete with comprehensive instruction book.

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SIZE: 8 x 9½ x 6 inches. WEIGHT: 8lb.

OTHER FEATURES: Plus and Minus D.C. Readings: Centre zero scale for F.M. Alignment: All ranges as listed above read direct on scale: Linear balanced push-pull circuit: 6inch sector type meter giving accurate readings with overload protection from circuit.

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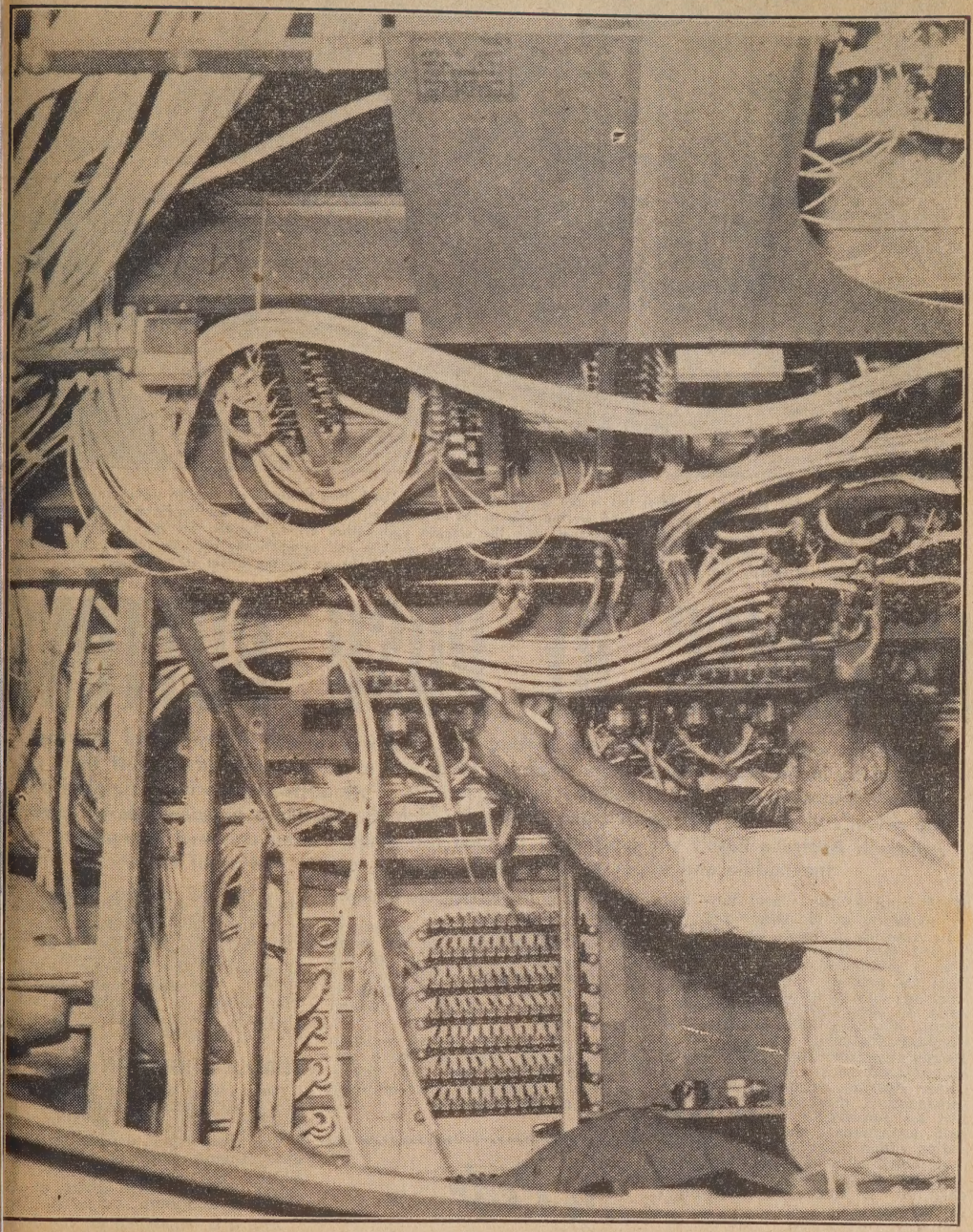
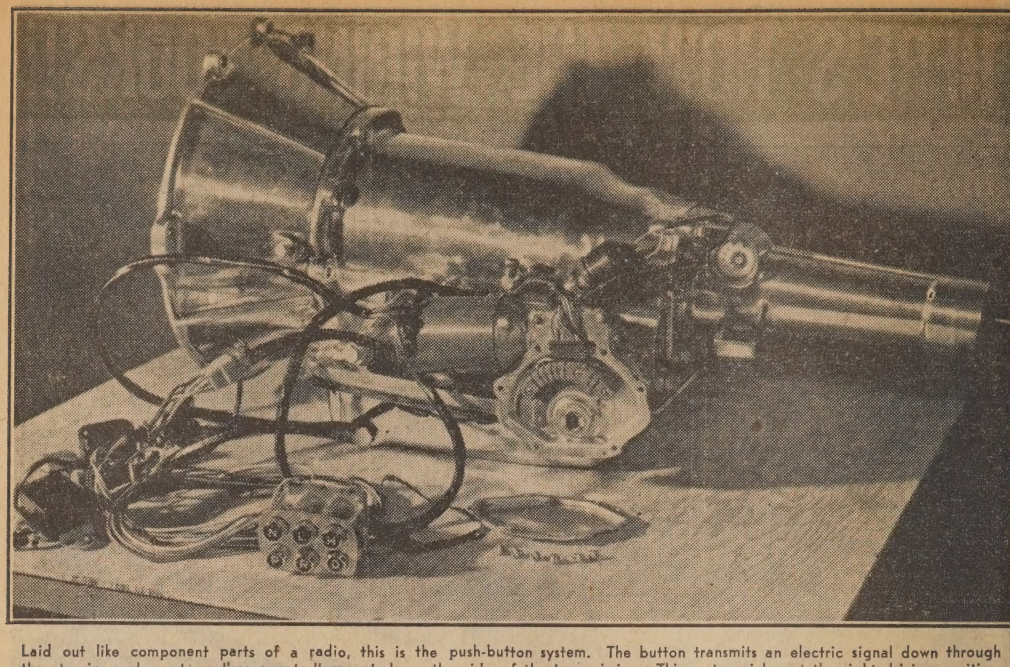
HERE'S HOW THE WIRING LOOKS!



This could be a "still" from the nightmare which followed your first attempt to wire up a big set. Actually it's nothing of the kind. It's Lockheed mechanic, Mike Marzano, working on a wooden mockup of a generator feeder panel for a new type plane—just one section of the electrical system. His aim is to check the practicability of engineering drawings.



Laid out like component parts of a radio, this is the push-button system. The button transmits an electric signal down through the steering column to a "serve-motor" mounted on the side of the transmission. This motor picks out the right driving position, as a jukebox picks out musical selections, except that, with the electric push-button driving system, the job is done in the smallest fraction of a second. The system incorporates a "safety-park" feature and automatically prevents shifting into either "Park" or "Reverse" at speeds over five miles per hour. There is no mechanical linkage for the driver to overcome.

MOTORING BY PUSH BUTTONS

Automatic and assisted controls are making big headway in the motor world overseas, particularly in the USA where competition is fierce, and motor manufacturers must think up saleable improvements to be featured in new models. Push-button operation is simple from the driver's viewpoint, but poses many problems which the ingenious engineer has to solve. Although Australia hasn't yet graduated to such refinements, their universal acceptance in the middle and upper price brackets may be only a matter of time.

by Pedr Davis

THE man at the wheel now has motoring at his finger-tips.

In America at least, the trend is toward fast, luxurious motor cars with a minimum of effort required from the driver. Push-button controls are offered as standard equipment on cars like the Ford Continental, Cadillac Eldorado and the Chrysler Imperial. Almost every Detroit manufacturer offers push-button windows, power brakes, power steering, finger-tip automatic transmission, mechanical hood control on convertible models, power seat adjustment and press-button radios which instinctively select the most powerful station in the neighborhood. If the feature is not standard, it is available as optional equipment.

A NEW ERA

The most dramatic claim yet in this field comes with the 1956 Packard models. The Packard-Studebaker Corporation say the new cars "usher in a new electric era in push-button driving".

In a recent statement on policy, the general manager of the same firm said it was the goal of his company to produce a fool-proof car which was so automatic that it overcame the frailties of human temperament and reflexes.

As proof of their pioneer work in this direction, Packards have announced an entirely new press-button automatic transmission known as Ultramatic.

Up to the present, "automatic" transmissions were not as effortless as is commonly supposed. A quadrant lever on the steering column is marked with either four or six positions—"Low", "Drive", "High", "Park", "Reverse" and "Neutral". The driver is required to select manually the necessary gear while the car is stationary.

THROUGH IGNITION

Once under way, the gear changing is automatic, provided that the lever is in the drive position.

The new system, devised by Packards (though Chrysler also have a similar idea) enables the driver to select any of these gears at the touch of a button.

And it is impossible for the driver to choose the wrong gear!

The system picks out the appropriate gear just as a juke box selects the right record. If the wrong button is pressed, nothing happens.

For example, if the "Reverse" button was touched accidentally while the car was moving forward, there would be no grating of gears. The gear in operation automatically locks out all other selections unless the driving conditions are suitable for gear changing. Thus "Low" gear could not be selected at 60 mph.

A further safety factor has been ensured by wiring the push-button control through the ignition circuit. A driver who activates the "Park" push button when he leaves his car on a hill, does so because it automatically locks the car and prevents it from rolling. There is no fear of a small child coming along and inadvertently pressing another button which releases the "Park" and allows the car to roll downhill. This is impossible because when the ignition key is removed, no other gear position can be engaged until it is replaced.

At speeds over five miles per hour, only the buttons marked "Drive", "High" and "Low" can be activated. The others are unobtainable to prevent any mechanical damage through wrong selection. In other words, you cannot tune into the wrong station.

The push-button system works both electrically and mechanically. The buttons are located in a console placed in front of the dashboard, facing the driver. Each button glows when it is activated so that a driver always knows what gear he is in. When a button is touched, an electric impulse is sent through the circuit to a servo motor. The motor turns in the proper direction to operate a worm and segment gear which rotates the range selector shaft. This shaft finally selects the appropriate gear by moving the gear selector forks of the gearbox. Once the selection is made, the electrical circuit is broken until another button is pressed. If the gear then selected is not obtainable the circuit remains inactive.

Like most mechanisms of this type, the operation is almost simultaneous.

Other press-button features which have now become either standard or optional equipment on all American cars are:

HOOD OPERATION

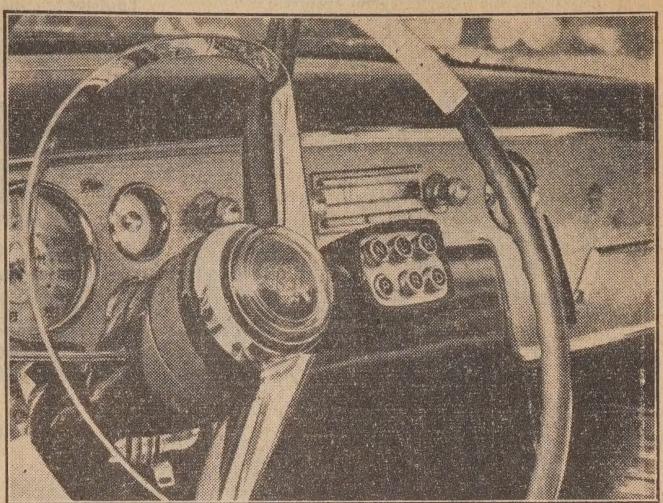
The canvas hood mechanism on convertible models is operated by a hydraulic unit, powered by an electric motor. It is therefore not necessary to have the engine running while the hood is being opened or closed. The driver pulls a knob which closes a circuit, operating the electric motor. Hydraulic fluid is pumped into the system and ram-type cylinders build up a pressure against the cantilever frame members of the hood. The driver needs to hold the knob out until the hood is in place. Once it is there, however, the circuit is broken and the mechanism cannot be damaged by holding on too long.

As soon as the hood is down, the valves of the hydraulic unit reverse and thus the hood can be closed again by pulling the same knob.

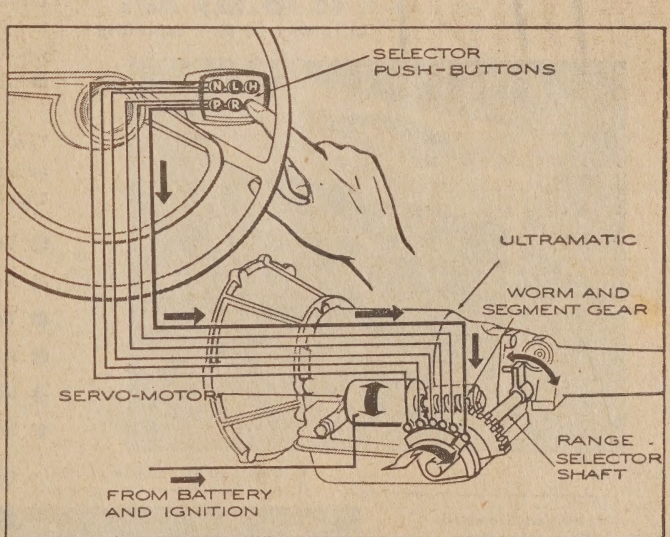
POWER WINDOWS

These are also electro-hydraulically controlled. Operation is extremely quiet and reliable. A row of switches is built into the driver's door to control all the windows.

HOW AUTOMATIC GEAR OPERATES



Packard models for 1956 will offer an electrically-activated push-button automatic transmission. The console control for the system is located on the steering column for easy accessibility, from where the push-buttons are nerved electrically to the transmission. By activating the "Park" push-brtton, a driver may leave his car parked on a hill or inclined driveway and forget about the possibility of a child accidentally disengaging the park-lock. Removal of the ignition key leaves the new Packard automatically locked in "Park" and it cannot be disengaged without opening the ignition circuit with the ignition key.



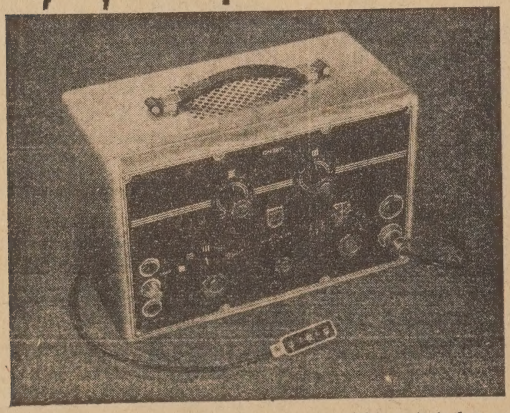
The electric push-button Ultramatic transmission for 1956 Packard. Operation of the system is portrayed schematically. The driver's forefinger puts touch-pressure on the push-button "D" for "Drive." With no mechanical linkage to overcome, touch-pressure of the forefinger sends electrical signal (course of signal shown by arrows) down from push-button console, located on steering column, through wire to "servo-motor". Upon receipt of electric signal, servo-motor turns in proper direction to actuate worm and segment gear which rotates range selector shaft which, in turn, chooses driving position indicated by driver's forefinger on push-button. The selection made, circuit of electrical power is broken off until need for another driving range selection. All this procedure takes place in the smallest fraction of a second.

PHILIPS TV TESTING EQUIPMENT

DESIGNED FOR THE TV SERVICEMAN

GM2891 TV SERVICE PATTERN GENERATOR 40 TO 225 Mc/s

CC1R with 5.5 Mc/s Separation



The Philips TV service pattern generator 40 to 225 Mc/s is designed for testing the overall performance of the TV receiver during those periods when regular transmissions are unavailable or unsuitable.

The Philips TV service pattern generator enables the following checks to be made:

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- **Synchronisation**
- **Transient response**
- **Audio channel**
- **Sound to vision distance**
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This unit is but one of Philips comprehensive range of radio and television measuring apparatus.

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PG36-55

There is also a separate switch below each window which is wired in parallel with the master. Thus either a passenger or the driver can open or close a window without leaving their seats.

To raise the window, the switch is flicked upward, to lower it is pressed down. To prevent strain, the motor cuts out immediately the window is fully open or closed.

POWER SEATS

The front bench-type driving seat of some cars can be moved in four directions by the press of a button. In others it can go in six directions — backward, forward, upward, downward or tilt in either direction. The operating mechanism is similar to that of the power windows. The control button is located on the driver's side of the seat base.

POWER STEERING

This innovation has proved to be one of the most popular of all power accessories. In particular it has proved a boon to ladies who find a big car too cumbersome to handle in confined spaces such as parking lots.

Initially, many power steering units were vacuum or air operated, but there is now a preference for hydraulic operation. Normally, steering systems have a three-piece track rod which is coupled to the steerable wheels. The basis of the power unit is to replace the centre rod with a hydraulic cylinder.

OTHER FEATURES

A fluid pump, which forms a single unit with its supply tank and relief and flow valves, is mounted on the side of the cylinder block or above the dynamo. It is driven by a pulley on the nose of the crankshaft. When the engine is idling and the steerable wheels are pointing directly ahead, the hydaulic fluid is pumped straight through the track rod cylinder, via the inlet and outlet ports, and back into the supply reservoir.

FASCINATING FEATURE

As soon as the steering arm moves either to the left or the right, however, cut-off points obstruct the flow of the fluid and a pressure builds up. This assists the movement either to the right or left, as required. The maximum operating pressure the mechanism is designed for is 600lb per square inch, though in normal practice 10lb is rarely exceeded.

Power brakes come second in popularity to power steering. Their chief advantage is the safety factor felt with the powerful, progressive braking. They also permit a wide, easy-to-locate brake pad (since they are invariably fitted to cars with automatic transmission and therefore no clutch pedal), which eliminates all risk of a driver unaccustomed to the car fumbling the brake in an emergency and being involved in a collision.

OVER-USE

The chief disadvantage of power brakes is that they encourage overuse (being so easy to use) and this is reflected in severe brake fade and lining wear.

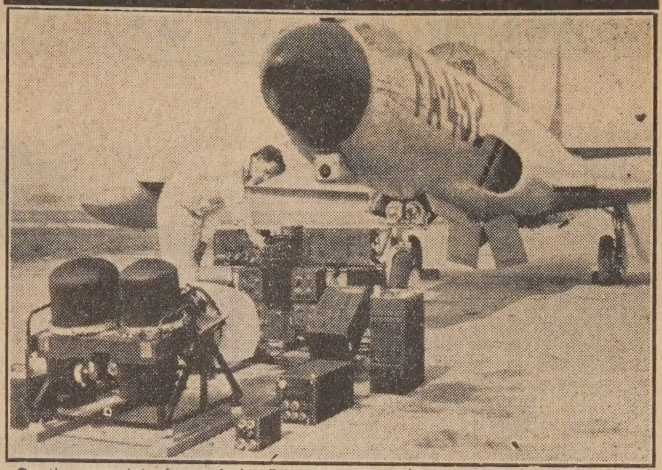
Power brakes are mostly operated by servo mechanism, driven by the engine so that the braking load is proportional to the engine speed. Thus the power assistance is more positive at higher speed than low.

Other press-button features which have been announced with the 1956 models are the Hi-Fi portable record player which takes special 25 rpm discs. Its sapphire stylus cannot be dislodged even under the most strenuous driving conditions.

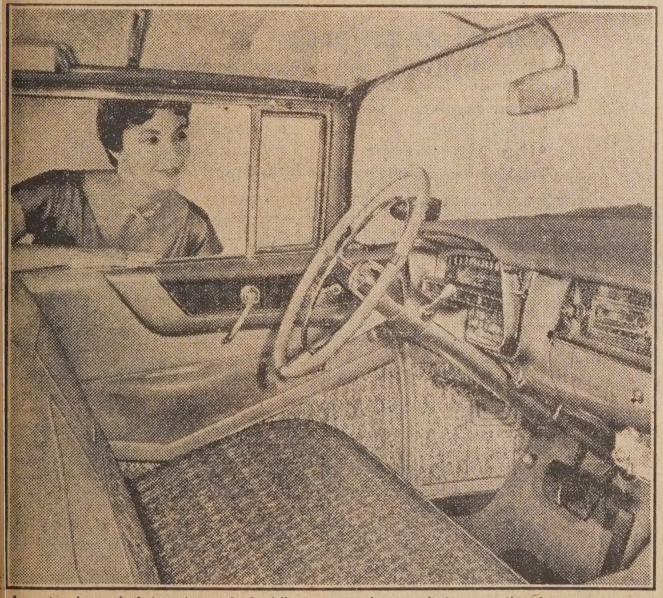
Some American firms and several specialised British coach-builders have built television sets into the rear compartment of "one off" models. It is expected, however, that the law will ultimately ban the inclusion of TV sets in the driver's range of vision.

Cadillacs have even offered a power-operated radio antenna.

BRAIN LOBES OF ELECTRONICS



On the ground in front of this F-94 interceptor plane are the different parts of the electronic brain used in the "seek-and-find" kill system which enables an interceptor to locate enemy aircraft at long range, regardless of visibility, direct the pilot to the target, and launch the armament at the correct instant. Despite compact construction, weight penalties are severe.



Luxuriously styled interiors of Cadillac's 1956 line include a strikingly new instrument panel which combines beauty with the utmost in functional arrangement. Among the features is a centre mounted glove compartment, twin ash receivers with cigarette lighters and a newly-styled instrument cluster. A newly created steering-wheel and a wide-pendant power brake pedal designed for either left or right foot braking.

2 NEW acos PICK-UPS

G.P. 60 & G.P. 50

G.P. 60 Incorporating G.P. 61 Ceramic Cartridge. The Pick-up for tropical conditions, unaffected by heat or humidity.
PRICE, £6/16/-

G.P. 50 Incorporating G.P. 59 Cartridge. A high gain Crystal Pick-up suitable for reproducing either standard or micro-groove records through low-gain amplifiers.
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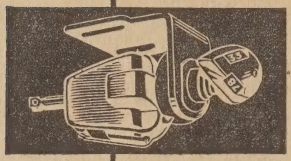


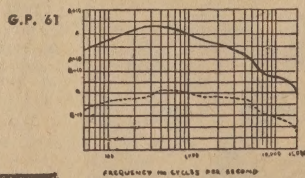
G.P. 61 CARTRIDGE

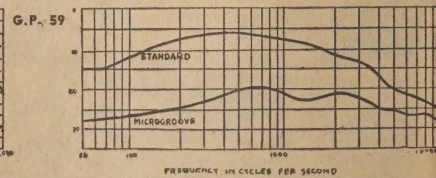
A Cartridge that will really withstand the rigours of a tropical climate and is at the same time very ROBUST.

SALIENT FEATURES:

- Tropicalised
- Smooth Response
- Low Stylus Pressure
- Easily Replaceable Styli

Tracking weight, 10/12 gms. **PRICE, £3/19/6**





Response Curves of G.P. 61 (left) and G.P. 59 (right) turnover pick-ups fed into a 1 megohm load

G.P. 59 CARTRIDGE

A medium quality HIGH OUTPUT (4 Volts) Cartridge suitable for reproducing standard and microgroove records through *low gain amplifiers* as those used in small record players and some radios (not comparable with HGP 37 or HGP 39).

SALIENT FEATURES:

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- Low Stylus Pressure
- Easily Replaceable Styli
- Hermetically Sealed

Tracking weight, 10/12 gms. **PRICE, 43/-**

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URANIUM—NEW SOURCE OF POWER

The term "metal" is used to denote a class of substances the commoner members of which are easy to distinguish and describe. Everyone must have some acquaintance with iron and steel, be it only through the use of knives at table and the humble tools of the garden. Water and gas are supplied to our homes through iron pipes and every modern kitchen can show some examples of the use of lead and copper pipes and aluminium cooking utensils.

By Dr. A. D. MERRIMAN G.C., O.B.E.

Miners examining the uranium in a piece of ore found at the old Wheal Edward Tin Mines, near St. Just, Cornwall. Samples contained as much as 25 per cent uranium oxide.

ZINC is the metal coating on the corrugated galvanised roofing sheets and on the domestic pail. Tin comes to our notice as the bright coating on the mild steel cans in which so much of our food is preserved.

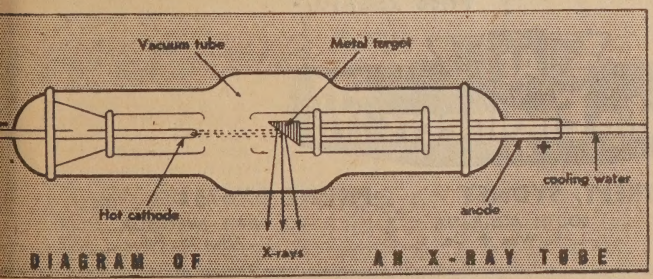
All these metals have certain properties in common. They are all fairly or even very hard and they do not readily melt. When placed in water they at once sink; they are capable of taking a fine polish, and wtih the exception of lead they have a ringing tone when struck. Of the common metals mentioned, all except copper are whitish or greyish-white in color. As a class they are very good conductors of electricity. Many metals are adversely affected by a moist atmosphere, creating problems in corrosion protection, in decoration, repair and replacement of corroded parts. The most noticeable of these effects are the "red rust" which appears on the surface of iron, the "white rust" that forms on zinc and the green patina that covers the surface of copper. Less obvious are the very thin coatings of "rust" that dull the surface of lead and aluminium. This corrosion layer is very compact and in the case of these two latter metals is able to protect the metal below it from further corrosion.

Now, these properties given above are not by any means the only ones by which scientists define metals. They are, however, the obvious ones by which the layman would probably decide the class in which a substance should be placed. How would uranium be classed on the basis of the above tests? It is very dense—much denser than lead; it is hard and sparks very readily when filed or sawn and when polished shows a faint bluish-white lustrous surface. It slowly corrodes in moist air; if left in water it slowly decomposes the water and the metal itself is corroded. The effect becomes very marked if the temperature is allowed to rise to boiling point. It is important to note this effect because it shows that it is essential that water shall not be used in contact with the hot metal as a means of carrying away the useful heat when the uranium is housed in the atomic pile.

Uranium is softer than steel and is malleable and when quite pure is highly ductile. The ductility at temperatures above 600 degrees C is remarkable. When heated or when rolled it expands, but the expansion is not similar to that of other metals, it is most irregular and is generally accompanied by a certain amount of distortion. Very small amounts of impurity in the metal cause it to become brittle.

GREY-BLACK COLOR

Just as powdered iron is much darker than the massive metal, so powdered uranium is grey to black in color. When mixed with a binder, the powder can be compressed into short cylinders and forms, after sintering—that is heating it in a furnace to a temperature below its melting point—a solid mass which can be rolled into wire. This is the usual method of making fine uranium wire which has some important uses in the electronics industry. When it is heated in a vacuum tube the hot wire can absorb even very tiny quantities of gas that remain and so help to maintain the vacuum. Unlike the majority of metals, uranium has a high electrical resistance, but when alloyed with copper an alloy having a very high conductivity is produced, and this alloy has the added advantage of being very resistant to



NEW NEW NEW NEW

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You can now replace worn out tips without removing the baton from the cartridge. Clip-in-tip makes stylus changes effortless. Available in both Sapphire and Diamond Tips.

TYPE AEJ-010A (01S and 03S) two sapphire tips. Price £4/16/6

TYPE AEJ-012A (01D and 03D) two diamond tips, £20

TYPE AEJ-013A (01D and 03S) two diamond, 1 sapphire £12/8/3

REPLACEMENT TIPS

TYPE	TIP COLOUR	DESCRIPTION	PRICE
AEJ-01S	Red	L.P. Sapphire	£2 3 9
AEJ-03S	None	78 Sapphire	£2 3 9
AEJ-01D	Black	L.P. Diamond	£9 15 6
AEJ-03D	Violet	78 Diamond	£9 15 6

THORENS

THE NEW CD43N
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Replacement Pick-up Heads

Plug-in white shell type No. AEX-P5SA, complete with variable reluctance pick up and type AEJ-010A stylus

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Plug-in white shell type No. AEX-P5SD complete with variable reluctance pick up and type AEJ-013A—(Diamond Microgroove Stylus)

PRICE £16-15-6

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VICTORIA: Simon Gray Pty. Ltd.

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corrosion. An alloy with nickel has been prepared, and when this is added to tool steels it produces in them the desirable properties of hardness and abrasion resistance. Tungsten has much the same effects and it is claimed that uranium could replace tungsten for this purpose. One very unusual application of uranium of special interest to the housewife is in the production of stainless silverware. This use has not been widely exploited because of the demand for uranium for other purposes.

PSEUDO-METAL

So, by the ordinary standard we have imposed, we could consider uranium to be a metallic substance, but the very unusual arrangement of the atoms in a crystal of uranium produces some effects not associated with metals and so scientists have been led to regard it as a pseudo-metal—a substance resembling a metal.

The accompanying sketch is a simplified diagram of an x-ray tube. The air is pumped out of the tube which is then sealed and an electric current is passed between the electrodes. This causes a stream of electrons to be produced at the cathode. These are allowed to impinge on a lump of dense metal

Autoradiograph of a high-grade specimen composed wholly of quartz and biotite with numerous grains of uraninite, mostly in the biotite. In this example, reproduced slightly less than natural size, halation tends to exaggerate the size of the uraninite grains. (Canadian Mining and Metallurgical Bulletin photograph.)

alled the target. The x-rays originate at the target and their nature epends upon the metal used. The sual materials employed are tungen, thorium and uranium. The atter is the most effective of the ree. The working of radio valves lso depends upon the production of stream of electrons from the athode. When tungsten cathodes re coated with uranium they produce a more copious stream of electrons and at lower temperatures.

Uranium compounds are used as

(Continued on Page 115)

A WORD ABOUT THORIUM

A VALUABLE RADIO-ACTIVE METAL

Thorium has been known for a century and a quarter. It occurs in at least a hundred minerals, but not by any means always workable quantities. It is a matter of some difficulty to prepare the metal from its ores because thorium is a very reactive element. When obtained pure it resembles lead in being greyish in color and malleable. On the other hand it resembles platinum in hardness. When prepared in powder form it is a glistening powder which by moderate pressure can be consolidated into a solid mass which has about the same density as lead.

By L. W. DERRY, B. Sc., M. Sc., (Tech.), F.I.M.

ON standing in the air for some time it corrodes slowly, forming a "white rust" called thoria. This latter was the substance deposited on the old gas mantles. And when it contained about 1 pc of ceria it produced a mixture that had excellent luminosity, even at the low temperatures of the gas flame.

At one time about 300-million of these mantles were used annually, but the coming of the electric lamp has very drastically reduced the demand for incandescent gas mantles.

But the commercial importance of thorium has increased, because of its use in radio valves where it is employed as a coating on the tungsten cathodes. This is a very important application because it ensures a more copious supply of electrons from the cathode at temperatures lower than would otherwise be required.

The metal also acts as a "getter", that is, it absorbs traces of gas present in vacuum tubes, and so helps to maintain the vacuum. Thoria is employed for making crucibles and in certain manufacturing processes where high temperatures are employed.

USEFUL ALLOY

Thorium and tungsten form a most useful alloy, and many thousands of miles of wire containing three parts of thorium to 400 parts of tungsten are now being made for use in radio valves.

When alloyed with copper and nickel or with chromium and nickel, alloys showing good resistance to high temperatures and which do not tend to form a scale on the surface when heated in air, are obtained.

Thorium is naturally radioactive. There is roughly about three times as much of this element in the earth's crust as there is uranium. In certain circumstances it is fissionable and thus could be used to produce atomic energy on a large scale. And as there is but one isotope of thorium, the lengthy processing that is required for the separation of the fissionable isotope of uranium does not arise.

As is commonly known, all radioactive substances lose their activity after a longer or shorter time. The decay of radioactive elements is expressed in terms of the "half life" which has been explained in other articles in this issue. The half life of thorium is of the order of 20,000-million years. It is first transformed into meso-thorium and this, with an average life of more than 12 years, is finally transformed into stable lead.

The radioactive properties of thorium and mesothorium are put to several important uses. The latter is cheaper than radium and about 30 times as powerful. It is usefully employed in the treatment of cancer and certain skin diseases.

Both are available for the important work of dissipating static electricity that is produced in certain manufacturing processes. These static charges arise through the passage of liquids through pipes, by the splashing of liquids in tanks, and in a variety of processes where insulating materials or fabrics are rubbed together in passing between rollers.

STATIC CHARGE HAZARDS

Petrol storage tanks and rubberising processes are among those in which sparking, due to the static charge, would constitute a considerable hazard. In other processes, plastic material on passing between printing rolls becomes charged and then attracts particles of dust which are not easily removed and whose presence is harmful to the appearance of the finished product. In all such cases thorium and mesothorium can dissipate the charge and eliminate the dust nuisance.

Finally, there is one possible use which awaits exploitation. If thorium were alloyed with the metals used in making the electrodes of sparking plugs, the air between the plug points would be ionised and would readily conduct a spark.

This really means that under all conditions the passage of the spark would be facilitated and the plug would become more reliable. The value of this in the case of aircraft hardly needs to be stressed.

FRENCH EARTH DAM

THE first earth dam to be constructed in Europe is expected to be completed by 1960 in the South of France, near Serre Poncon, just above the junction of the Ubaye and Durance Rivers. It will provide water for irrigation as well as electric power.

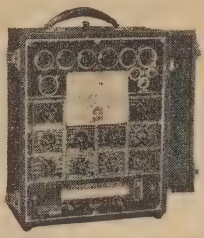
Supported on a reinforced concrete foundation, it will be 395ft high, 2132ft wide at the base and 1968ft at the crest. Eleven miles in length, the lake behind the dam will have the largest capacity in the whole of Europe, allowing 1-billion 100-million KW-hours of electricity to be generated per year.

Sufficient water will be released to allow for the irrigation of about 180,000 acres.

UNIVERSITY service aids . . .

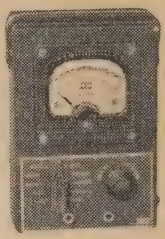
IMPROVED OSCILLATOR

Model YOA. Gives dynamic on-the-beam performance, and new Vernier or fast drive dial makes for quicker and easier tuning. Has improved attenuation system and the dial is calibrated in spot frequencies for quick tuning over the main alignment points merely by changing the switch. Has continuous coverage from 30 megacycles to 150 KC in overlapping bands. Write for free illustrated leaflet.



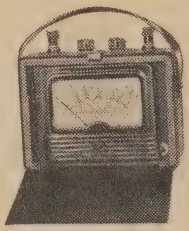
VALVE & CIRCUIT TESTER

Model T.S.T.: This versatile happy instrument operates from either 240 volts A.C. or a 6 volt battery. This makes it ideal for bench or portable use and it combines the functions of an up-to-date valve tester with a wide range circuit tester covering D.C. and A.C. volts as well as output volts, condenser checks, current and resistance. Write for special bulletin.



MODEL ACM

An AC/DC Multimeter readily portable reading up to 500 volts both AC and DC as well as direct current in several milliampere ranges. Self contained resistance readings to 100,000 ohms. £14 plus Sales Tax 12½%



Model EXT/2: Readily portable, this low and medium range ohmmeter is mounted in hard rubber case with hinged protecting flap over the meter. Uses 4in square meter Model R4—Ranges 0-20, 0-500, 0-5000 ohms. £12 plus Sales Tax 12½%.

SIGNAL TRACER PROBE B8

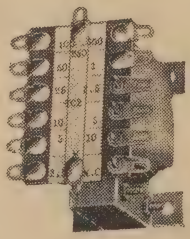
Moulded of high quality black bakelite and fitted with brass tip, this probe will take a small valve or germanium crystal. Ideal for signal tracer work. Fitted with 7-pin valve socket. 12/6 plus Sales Tax.

MODEL B10

Illustrated here is the University Model F3 meter mounted in a sloping front bench stand and fitted with terminals. This type of meter and stand is widely used for instructional work and bench type testing in laboratories. It is ideal for experimental setups and the sloping face allows the meter to be quickly seen under all conditions. It follows a conventional standard pattern and is sturdily constructed and light in weight. Fabricated of steel and finished in grey brocade it is hard wearing. It is ready stamped and drilled to accommodate the F3 meter and is supplied with bakelite terminals with non-removable tops. It can be supplied with or without meter.

30 KV TEST PROBE

Model B13: Although this high voltage probe is primarily designed for 30,000 volts test circuits, it offers a wide number of uses where polystyrene probes are required. It can be used for signal tracing work, high voltage work or a variety of other applications. Available with red or black handle as required.



CURRENT TRANSFORMER C/T1

For moving iron meters. Auto type. Secondary for 0/1 Ammeter and will extend ranges to 0/2½, 0/10, 0/25, 0/50, 0/100 Amperes AC. £6/10/- plus Sales Tax.

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ATOMIC RESEARCH IS PAYING OFF

The Man in the Street—and while we are thinking of him we must not forget the Woman in the House—pays his taxes and so helps to finance the country's programme of research and development in the field of nuclear energy. What does he receive in return?

By J. F. HINSLEY
(Research Department, Edgar Allen Steel Works, Sheffield)

FIRSTLY, he gets security consequent on the possession by his country of weapons which should be an effective deterrent to aggressors.

Secondly, he gets some peace of mind from the thoughts that production of electric power from nuclear energy is being vigorously pursued and that our most valuable raw material—coal—stands a good chance of being reprieved from its "fate worse than death", that of being burned smokily and wastefully in firegrates and under boilers.

Thirdly, he gets—even today—innumerable benefits in his daily life as the result of a wide use in industry of radioactive isotopes, produced by the Atomic Energy Research Establishment. It may help us to appreciate the range of these benefits if we consider some incidents in a typical day in the life of a certain Mr. and Mrs. Smith.

The alarm clock which rouses him from his slumbers, works efficiently because its driving springs are rolled to a very uniform thickness, this uniformity being assured at the steel mill by a monitor incorporating a radioactive isotope.

Within a short time of rising, he may use a plastic sponge bag or a razor blade, walk on linoleum, open a packet of breakfast cereal or read a paper, where in each instance the thickness of material has been kept constant by a similar monitor.

THE BUS ENGINE

In the bus on the way to the station he may reflect that the life of the bus engine, between overhauls, has been greatly extended by the use of isotopes in research into materials, friction and lubrication.

The fact that these reflections may also lead him to the idea that fares should be reduced in consequence is interesting, but does not concern us here.

At the station, Mr. Smith gets into a train and rides safely to the office, his peace of mind assured by the knowledge that the steel castings in the motors and other parts of the train, have been radiographically inspected using isotopes and passed as sound.

In the meantime, Mrs. Smith decided to have a washing day. One of the first things she did was to open a packet of soap powder, little realising that she got full value because somewhere in the soap factory an ever watchful isotope made sure the packet was properly filled.

Of course, being washing day, time was short and lunch came out of a tin. All the same, it was an excellent lunch; you see the thickness of the tin coating on the tinplate was assured by a monitor using an isotope, so the food was in first-class condition.

Mrs. Smith had hardly finished her lunch when the postman brought her a letter. The letter was from her sister who unfortunately was in hospital as a result of a motor accident (no, they have not yet found a way of stopping these by means of isotopes). The letter was a cheerful one; all her damaged looks had been fully repaired by the plastic surgery and she was very happy.

It seemed that when the surgeons made a skin graft, they checked with a radioactive isotope of sodium to see whether the blood was circulating properly in the graft. Having made certain on this point, they were then able to go on with the next part of the operation. She thought it was marvellous.

THE DAY'S MAIL

Meanwhile, Mr. Smith had arrived at his office and started to answer his mail. It will by now be hardly a surprise to you to learn that the thickness of the carbon on the typists' carbon paper had been kept to a suitable value by an isotope monitor!

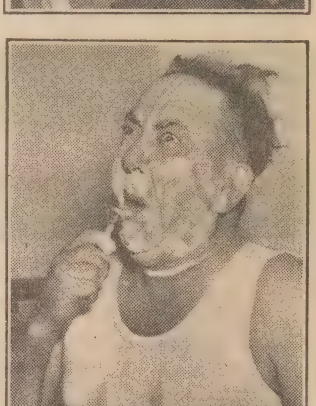
Mr. Smith got through his work well because good ventilation without draughts existed in his office (just a few experiments with a whiff of isotope Argon 41 had settled the ventilation arrangements). As he was a consulting engineer, we might peep at some of the letters he wrote.

We find one letter referring to tracing an underground stream by means of radioactive isotopes added to the water; another about testing undersea cables for leaks.

Mr. Smith was also interested to find out how long the firebrick lining blocks of a blast furnace would last, and arranged to have small pellets of cobalt 60 put in selected blocks at different depths. The presence of these pellets could be checked every day from outside the furnace.

When in due course the block wore down to the level of the pellet, this would be eroded out of position, and its absence would be noticed and interpreted accordingly.

We could probably go on in this vein for quite a while for the everyday use of radioactive isotopes is increasing rapidly—whether or not Mr. and Mrs. Smith fully realise it. That it is doing so is a tribute to the work of places like Britain's Atomic Energy Research Establishment at Harwell.

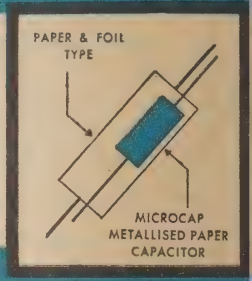


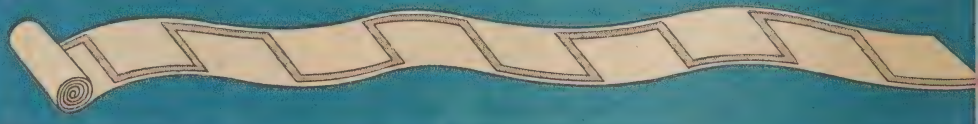
One's early-morning activities may involve many items produced with the aid of atomic energy.

MICROCAP

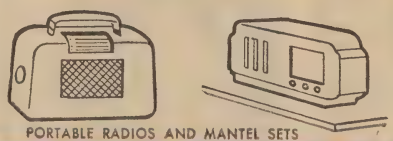
the capacitor which saves you space and money...

BECAUSE it allows miniaturisation of equipment and easier assembling and soldering into circuits employing miniature valves





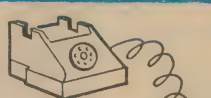
MICROCAP for:—



PORTABLE RADIOS AND MANTEL SETS

TV SETS

AUTO RECEIVERS and TRANSCEIVERS



COMMUNICATIONS EQUIPMENT

The Microcap capacitor uses the exclusive metallised paper technique, which consists of lacquered paper tissue on which aluminium has been deposited by evaporation and condensation in vacuo.

This results in the deposition of a very pure metal with a thickness controlled at approximately four-millionths of an inch.

This produces a lightweight, ultra-miniature space saving capacitor, which saves time and money when trying to "squeeze" components into limited space.

Another valuable characteristic of the Microcap is the "self-healing" feature which enables it to sustain accidental over-voltage, and provides an additional safety factor.

The Microcap gives stable long life in miniature form, and is available in a wide range of capacitance values and voltages.

Manufactured in Australia under licence from A. H. HUNT (Capacitors) Ltd., England

AUSTRALASIAN ENGINEERING EQUIPMENT CO. PTY. LTD.
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NEW SCHOOL FOR TV, ELECTRONICS

The Director of Technical Education, Mr. A. Denning, has announced the commencement of a new school in Sydney which will provide specialised training for the radio, television and electronics industry. In general, instruction will proceed from Intermediate or Trades certificate level for additional periods up to about four years.

MR. R. H. Mondel has been named as the head of the department's new School of Electronics and Communications. Mr. Mondel is an Associate of the Sydney Technical College in Electrical and Radio Engineering and a Bachelor of Engineering of the University of Technology. He has recently returned from a three years' period of study at the Massachusetts Institute of Technology where he gained the degree of Master of Science (Electrical Engineering).

RAPID DEVELOPMENTS

He will be assisted by Mr. M. D. Jobels who has been head of the Radio Trade School at Leichhardt-Petersham Technical College since 1953 and an experienced teaching and technical staff.

Reason for establishing this new school in the department has been the rapid development of the electronics industry in New South Wales, particularly since the commencement of World War II.

As a consequence of this sudden upsurge and the rate at which the science of electronics has progressed, the industry now faces a critical shortage of trained personnel. The advent of television to capital cities this year will aggravate the problem even more.

The effects of this shortage of skilled manpower must be to impede the development of Australian secondary industry and to deprive the Australian public of their proper share of the benefits of modern scientific development.

It is to provide a steady supply of properly trained personnel and thereby maintain the industry at its proper level that the Department of Technical Education is proceeding with its new school this year.

The school will be located at the North Sydney Technical College, Gore Hill, and will begin active teaching operations this month. Enrolments for the planned TV Station Operators and the Electronics and Communications Certificate Courses are to be arranged at North Sydney while the Television Servicing and the Radio Trade Course enrolments will be made at Leichhardt-Petersham Technical College.

The new buildings for the school are well advanced and will be completed before the beginning of the second term of this year.

Equipment for the School includes a complete television studio and control room, similar to those used in a modern TV broadcasting station, and a television laboratory with test equipment and receivers.

RADAR TECHNIQUES

Radar and pulse techniques will be catered for by a special pulse technique laboratory and a transmitter laboratory will be provided for the study of the more conventional radio communications. Special laboratories will contain electronic equipment and facilities for servicing broadcast receivers.

Arrangements are also in hand for the transfer of the laboratory and teaching equipment of the Leichhardt-Petersham centre during May and the concentration of all courses in electronics at North Sydney Technical College, Gore Hill.

The list of courses which are being planned to operate as from the beginning of 1956 at Leichhardt-Petersham and North Sydney, showing the duration of each course and the entrance requirements, is set out in the accompanying table.

In the case of the Radio Trade Course, though these requirements are not stated, it is generally desired that each student shall have reached the Intermediate Certificate or equivalent standard.

COURSE	DURATION	ENTRANCE REQUIREMENTS
Radio Trades	4-years Six hrs. weekly	Apprenticeship or prospective apprenticeship. Radio or allied trade.
Industrial Electronics	1-year	Radio or Electrical Trade course, or equivalent qualification.
Television Receiver Servicing	1-year Six hrs. weekly	Radio Trade course or equivalent, or sound knowledge of Radio and Electronics
Television Station Operators	1-year Nine hrs. weekly	Broadcast Station Operators Certificate of Proficiency or equivalent
Electronics and Communications Certificate	4-years Nine hrs. weekly	Intermediate Certificate with Mathematics I and II, and Science

The Director of Technical Education in New South Wales, Mr. A. Denning.

The Electronics and Communications' Certificate course aims at producing technicians for industry and for equipment servicing—men who can intelligently interpret instructions from engineering staff and also supervise tradesmen at work on radio and television, navigational aids and industrial electronic equipment.

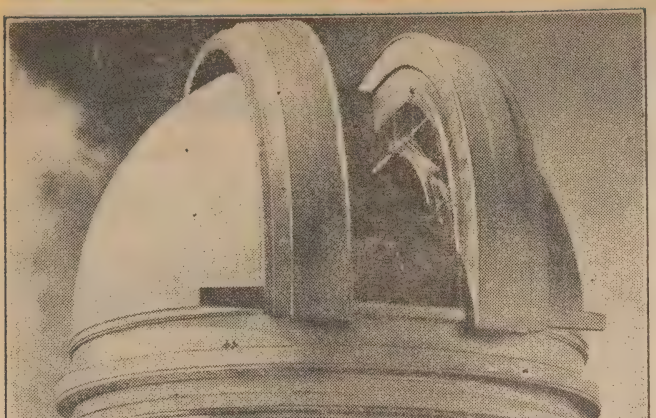
In particular, the course seeks to train men in the elements of detail design work, carrying out measuring and recording, testing equipment in accordance with specifications, writing technical reports, fault-finding on complex electronic equipment and effecting repairs.

MATHS AND PHYSICS

Because of the complex nature of modern electronic devices (and hence the subject matter of the Electronics Certificate course), it is essential that the student be properly grounded in mathematics and physics. These subjects are given their due prominence in the opening two stages of the course in which they occupy slightly more than 50 pc of the teaching time.

Students in the final year of the course will have one of four options, viz., (1) Telecommunications; (2) Television; (3) Navigational Aids; and (4) Industrial Electronics. In telecommunications, five out of the nine hours weekly will be devoted to transmitters and receivers.

The program of the Television Servicing Course of one-year's duration is six hours weekly, of which two are devoted to circuit and allied theory, and four hours to practical work. The students, working in pairs, build and test a television receiver, stage by stage, to its completion.



"Glamor" telescopes like the 200-inch giant at Mount Palomar will be active during the Geophysical Year but a wealth of information will also be supplied by numerous smaller observations scattered over the earth and working to a co-ordinated plan.

PROBING EARTH'S MYSTERIES

From July 1957 to the end of 1958 scientists from more than 40 nations will combine in a mass effort to learn more about the nature of our earth, its atmosphere and immediate cosmic neighborhood.

by Calvin Walters

THE period during which this highly organised effort will be made will be called the Geophysical Year although it will really extend to a year and a half from July 1, 1957 to the end of 1958.

The first combined effort of this kind was made in 1882-1883. It was called the International Polar Year because it was concerned mainly with improving Arctic knowledge of meteorology, magnetism and the aurora.

The second effort took place 50 years later in 1932-33 and again concentrated on studies of the arctic with a slight widening of the field to include some lower latitudes.

LIMITED FACILITIES

Because of limitations in technical facilities available at the time, the first effort in 1882, although it enhanced our scientific knowledge of the arctic, did not produce results comparable with the cost of the effort.

However, "every little helps", and it was a start to bigger and better things in the second period in 1932.

Then, in 1939, came World War II and the development of radar and rockets and so forth.

Scientists were soon convinced that what they did before was almost nothing compared with what they could do now. They saw that much of what they had formerly taken for granted was really not what it seemed.

Scientists have always been that way and he changing viewpoints have given the impression to laymen that scientists are a body of cranks who are always peering into something which, although mighty interesting, doesn't matter a tinker's hoot anyway.

In fact, the general public seems to be getting the idea that the scientists will eventually blow us all to glory before our time, with "A" bombs, "B" bombs, "H" bombs and so on. This alphabetical progression through the bombs is no good at all and is upsetting everything, says Mr. Public!

But Mr. Public has always been much in the dark about the beneficial aspects of scientific research into the earth, sun, atmosphere and space.

He is informed mostly about the disastrous aspects which are matters of conjecture by certain scientists such as when the earth will blow up, how the sun is getting colder, how the polar ice is melting and will eventually drown us all; collision with comets, invasion by people from other planets, radio activity from "A" and "H" bombs wiping us all out and many other ghastly ends to existance.

WHAT IS PROPOSED

Things are not really as bad as all that and it is the purpose here to try and sort things out a bit and see just what the scientists propose to do in the new Geophysical Year of 1957-8.

The term Geophysical Year has been applied this time because the research will be into the earth's physical aspects, the land, oceans and atmosphere.

This organised drive will be much better than observations by individual scientists, because it will bring together all the available modern resources, and groups of men all over the world will specialise in certain aspects at different points all over the globe. Thus what one group may miss, because of some local weather condition, will be observed by another group somewhere else where conditions will be more favorable.

Because the atmosphere is so important to our daily life in relation to the weather, our food supply and comfort, a special effort will be made to elucidate some of its mysteries with special reference to the atmosphere at high altitudes.

WEATHER CONDITIONS

The weather lately, all over the globe, has been so much at variance with local forecasting that the measuring of pressure, temperature, humidity, wind and rainfall at near ground level is no longer accurate enough.

I notice, too, that some effort will be made to check the concentration of carbon dioxide in the atmosphere. There is a suggestion afoot that increased carbon dioxide content, resulting from increased mechanisation and decreased forestation, is producing a "blanket" effect and raising the average temperature of the earth's surface.

TO SEARCH OUTER ATMOSPHERE

New methods are making it possible to explore the atmosphere at great heights. It has been found that, at great heights, there are fast, wandering streams of air moving at velocities of up to 200 miles an hour. Because these streams, called "Jet Streams", no doubt influence our weather by moving vast quantities of air from one place to another, they will be investigated more thoroughly than ever before.

With air transport getting into higher levels, these jet streams will be of very great importance to development in that direction.

Closely allied with the investigation of the atmosphere will be the oceans of the globe. That our weather and rainfall are governed by the action of the sun's rays and wind on the water of the oceans is beyond doubt.

The ocean currents are brought about by the heat of the sun warming the water unequally at different points. Thus the land, sea and atmosphere in other regions is warmed or cooled by these wandering currents. This in turn affects evaporation and ultimately the rainfall.

The evaporation of the water in sub-tropical oceans is the responsible agent for the heat energy contained in the atmosphere but the actual process by which this energy is transported throughout the atmosphere remains much of a mystery.

OCEAN DENSITY

If this mystery was solved it would go a long way to make for more accurate weather forecasting.

The evaporation of ocean water also alters the salt concentration and the density of the ocean water. This in turn affects the life in the oceans on which we depend so much for our food supply.

This link-up between the atmosphere and the oceans is thus seen to have a very widespread effect on our daily lives, because it influences our weather and our food supply both from the sea and from the land, which depends on rainfall for its productivity.

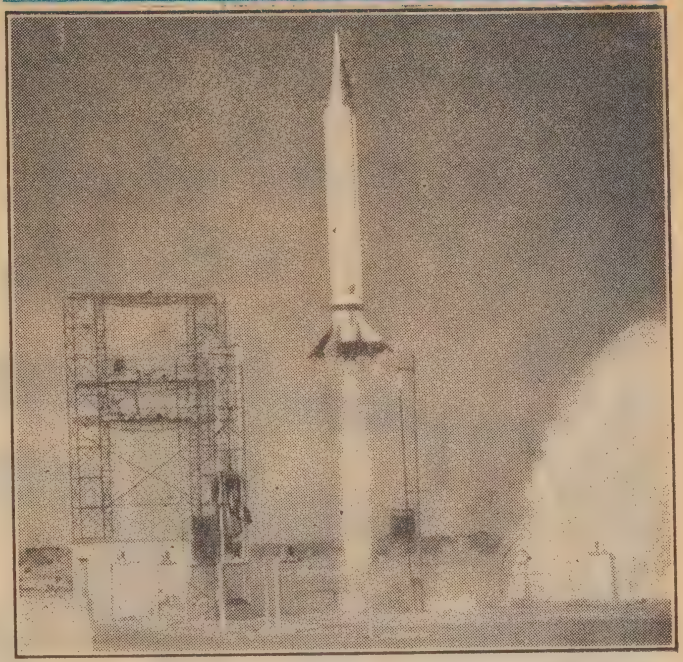
Simultaneous observations by stations at different points will therefore be of great value in providing information which can be utilised for our ultimate benefit.

Do not think, however, that our weather forecasters will be able, at any time, to forecast weather which will suit everybody at the same time. The ideal, of course, is to be able to turn any kind of weather on or off at will just over our little bit of property. This will never happen and the weather man is thus doomed to remain a man who is both praised and cursed at the same time for the whole of his active life.

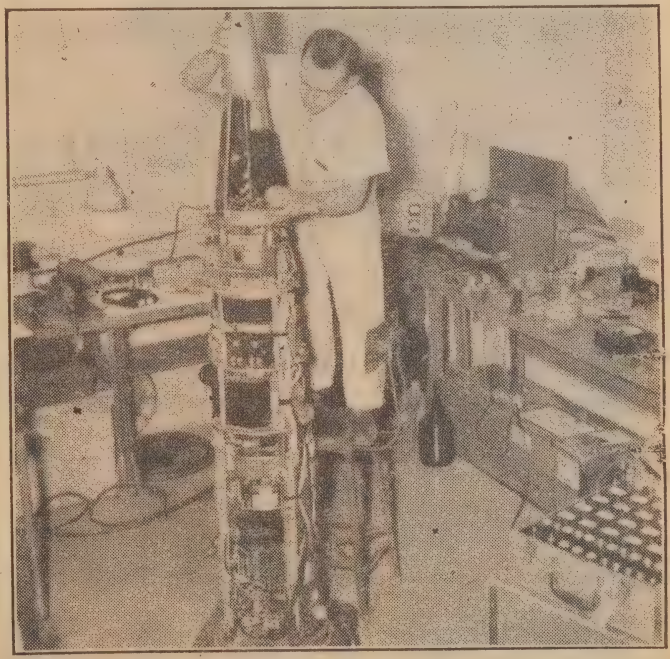
Above a height of about 60 miles, space is packed with forces which are both peculiar and awesome.

Although this region is beyond that where weather changes take place, it has a very great influence on these changes and also on radio and cable communication.

This region is called the ionosphere and consists of electrically charged particles both positive and negative in character. Were it not for the ionosphere, we would suffer greatly from the effects of ultra-violet rays.



Research rockets carrying a varied array of instruments will provide data about conditions in the ionosphere. The US alone plans to fire more than 200 rockets



A project engineer from the Michigan University checks over the instrument head of a rocket destined to reach 90 miles — a modest figure by present standards

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M43RTFP

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The ionosphere absorbs much of these rays from the sun and allows only enough to go through to give that wonderful tan seen mostly on shapely beach girls. These in turn influence the behavior of the human male, so the far-reaching effects of the sun are marvellous, aren't they?

In absorbing the ultra-violet rays this layer called the ionosphere becomes electrically charged. This charge is augmented by streams of gas emitted by the sun, which enters the ionosphere at high speed.

To further add to the mysteries to be investigated, these streams of gas are guided into the atmosphere by the earth's magnetism. This is especially so in the polar regions.

INTENSE ACTIVITY

During the most intense periods of activity produced by sun spots, these streams of gas have so violent an effect on the ionosphere that the aurora or polar lights are generated high above the earth in a most awe-inspiring display. These are called ionospheric storms.

As mentioned, the storms are most pronounced when spots occur on the face of the sun and when violent eruptions are observed in the spots. These are called solar flares and form part of the solar storm.

These storms are of gigantic dimensions. Scarlet tongues of flame are ejected from the rim of the sun and are ejected into space for distances of 250 thousand miles. Sometimes these are spread over an arc of the sun 400 thousands miles in extent.

The jets of flame are projected at a speed of scores of miles a second into outer space. They are produced in vast clouds of superheated hydrogen gas.

During the storms the sun emits very intense radio waves of short length, which only add to the confusion brought about during this intense sun spot activity.

When these storms occur, disruption is caused to radio communication on the earth. It will be to our great advantage to be able to predict with accuracy the advent of a storm and its effect on communication.

AFFECTS CABLES

The solar storm also affects cable communication, although the cable is submerged by water. It seems that the solar storm has an effect on the earth's magnetic field. These disturbances in the magnetic field are called magnetic storms. Although they are particularly strong in the higher latitudes they affect the whole earth at the same time.

Within a split second a storm can develop and all cable communication thrown into confusion simultaneously.

It is hoped during the Geophysical Year to be able to predict these storms several days in advance. Stations erected at intervals over the globe will, on selected days called "World Days", make simultaneous observations which will be transmitted to headquarters.

Together with the information given by the Solar Noise Patrols, who will observe the sun with radio telescopes for unusual radio activity, other information will be pieced together and storms predicted. Observers throughout the global network will then be alerted so that they can study the phenomena and the effects upon weather and radio communication.

Another mystery to be investigated during the Geophysical Year is the faint glow in the air of the ionosphere. This is called "airglow". No one knows what it is and what causes it. It is world wide and seems to have no connection with the aurora.

In conjunction with the study of "airglow" the deadly rays called cosmic rays, will be studied in great detail. These rays are perpetually bombarding our planet with energy so great that they can penetrate many yards of earth. Fortunately our atmosphere protects us from the cosmic rays by absorbing the greater number of them.

SOURCE NOT KNOWN

It is not known whether these rays are projected from the sun or from some other object in the depths of outer space.

It is a peculiar phenomenon that during some solar storms the flow of cosmic rays is altered by as much as ten pc while other solar storms have no effect whatsoever.

During the Geophysical Year the cosmic rays will be studied simultaneously by observers all over the world from high mountain tops. Information gained may decide whether the cosmic rays have any influence on our daily life.

The earth itself will come in for quite an amount of investigation during this important period.

Although maps of the globe depict the land masses of the earth as having a certain contour, it has never been accurately established whether these contours are really as shown. Neither has it been established with any certainty whether the earth is exactly the shape and size as popularly supposed.

SURVEY PROBLEMS

An exact survey of the large continental land masses whose surfaces are substantially curved, is not easy. The long lines of sight, which are involved and along which the light rays are bent by diffraction, make such surveys extremely difficult.

It is more difficult to survey across vast areas of oceans between the land. In addition to all this, plumb lines differ in direction in different places and are also subject to errors caused by attraction of mountains and rocks.

Concerted efforts will be made during the Geophysical Year to determine more accurately the shape of the earth, its size and the contour of the continents.

Much valuable data may be obtained by actual photographs transmitted from the artificial satellites,

(Continued on Page 111)

BALLOONS DETECT COSMIC RAYS

Huge polyethylene balloons like this one, measuring nearly 300 feet long, can carry instruments to heights well over 20 miles. They provide an excellent means of checking cosmic ray effects and activity.

The WARBURTON FRANKI Page

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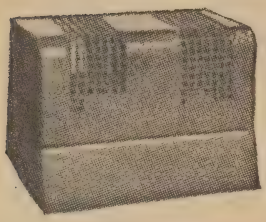

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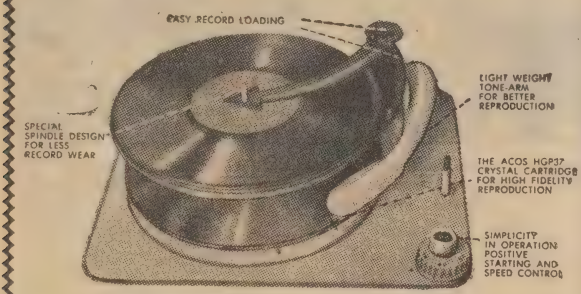
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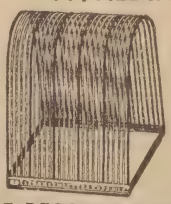

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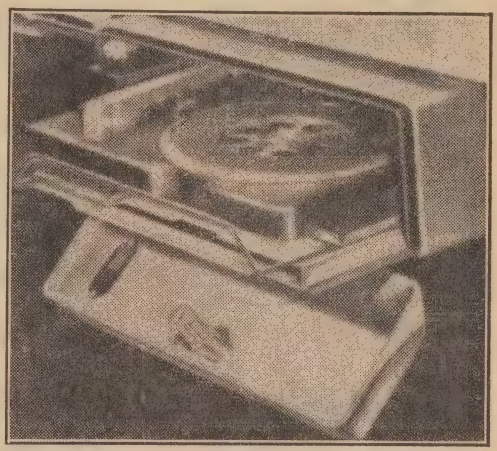
Technical Review

NEW RECORD PLAYER GIVES MUSIC WHILE YOU DRIVE

American car buyers who purchase any one of the Chrysler Corporation new 1956 models, don't have to rely for their entertainment on programmes available on the regular car radio. Beneath the dash is a spot for a newly designed record player, which gives them music of their own choosing, anytime, anywhere.



A close-up view of the new player, withdrawn from its cabinet and ready to receive one of the special new 7-inch long-playing discs.

TO make possible this novelty—which might easily prove a real winner—engineers of the Chrysler Corporation and the Columbia Broadcasting System had to solve several sticky problems in one.

First and foremost, they had to make the gadget shockproof, so that the stylus would not go skating across the record every time the car hit a bump or screeched around a sharp bend. Anyone who has had much to do with regular microgroove players will know just how sensitive they are to bumps and vibration.

Their first and logical step was to make the turntable good and heavy, both to guard against "wow" and to make it resistant to bumps.

The table and its mounting plate was supported on 1¾-inch neoprene sponges, which gave plenty of cushioning without excessive "bounce".

SPECIAL TONE ARM

Next, they designed a special two-unit tone arm.

The rear section of the new arm swings horizontally on ball-bearings, but its movement is damped by a selected silicone fluid. The arm will move freely, provided the movement is only slow, due, for example, to the sideways tug of the record grooves.

But anything which wants to make the arm move fast finds it a difficult propostion. The silicone fluid just won't be hurried!

At the front of the arm, a separate counterweighted section carries the pickup head. It can move up and down with variations in record height, but is held in contact with the groove by light spring pressure, equivalent to about one-tenth ounce.

The head is a ceramic type, rather similar to a regular crystal in its characteristics, but more robust and not so easily affected by temperature and moisture.

The records operate on a new standard of speed and groove size. They measure seven inches across, like some of the current microgroove types, but they spin at a fraction over 16 revolutions per minute.

The grooves are finer and the stylus of smaller dimensions than in regular microgroove discs. This makes it possible to preserve good frequency response and low distortion at the reduced speed.

The net result is that the records play for upwards of 45 minutes per side, which would seem to be ample for any occasion. If it isn't, the record can be turned over or a new record slipped into place with no more driver-distraction than tuning a regular car radio.

NO DISTRACTION

The player is simply pulled out drawer-fashion to expose the turntable. The new record is pushed in against guides and stops, then lowered straight down over the spindle. The operator doesn't have to take his eyes off the road.

Pressing a lever alongside the turntable, raises the pickup and lets it swing into position. Releasing the lever drops the pickup onto the first groove, and the player starts to spin. Another push and the whole concern slides back into its drawer, the front lid is closed and the speaker gives forth with the music.

At present each player comes complete with a selection of appropriate discs, but additional numbers are available from the Columbia catalogue. Plans are afoot to extend the range of discs, to include numbers specially for children and even to produce "travelogue" discs describing certain of the main tourist routes.

MUCH RESEARCH

The apparent success of the venture is the culmination of a long-standing ambition of CBS research chief, Dr. Peter Goldmark. For years he had dreamed of putting some kind of a player into American cars. For a while it looked like being a tape gadget, but experiments indicated that a record player would be the better proposition.

What the future holds for the discs—and the new equipment—no one can say. Dr. Goldmark says the CBS has no plans to market either for home use, though the demand might easily come. Frequency response is adequate and the discs appear to be both cheap and robust.

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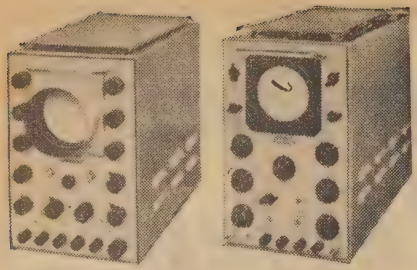
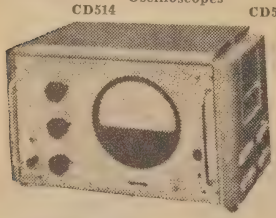
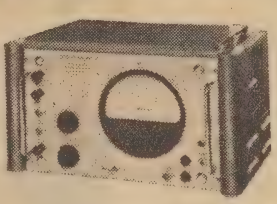


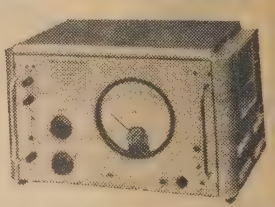
Oscilloscopes
CD514 CD513



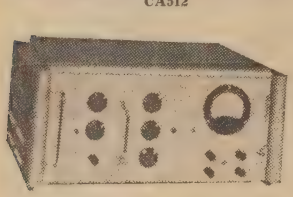
Voltage Standing-Wave Radio Indicator
CA512



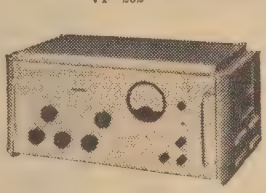
Feedback Voltmeter
VF 252



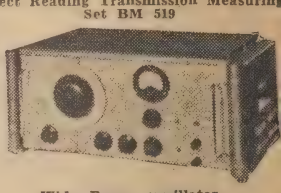
Direct Reading Transmission Measuring Set BM 519



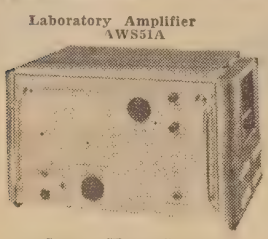
Laboratory Amplifier
AWS51A



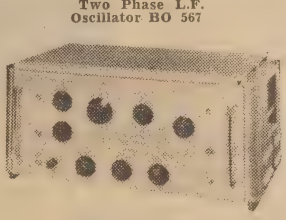
Two Phase L.F.
Oscillator BO 567



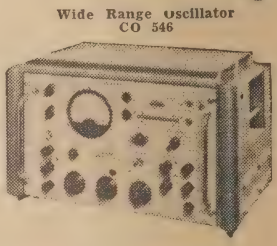
Wide Range oscillator
CO 546



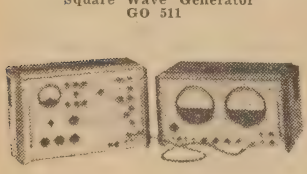
Square Wave Generator
GO 511



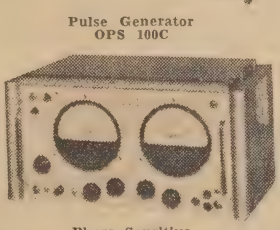
Pulse Generator
OPS 100C



Calibrating Unit
AT 203

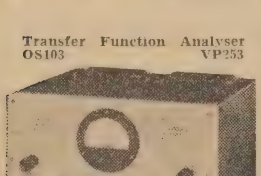


Transfer Function Analyser
OS103 VP253



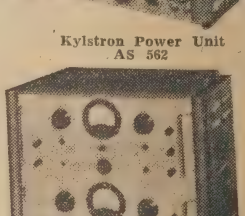
Phase Sensitive
Voltmeter VP250

Kylstron Power Unit
AS 562



Solartron Vari Pack
SRS 153

Regulated Power Supply Unit
SRS 151A



Twin Regulated Power Supply Unit
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HOW TO DESIGN GOOD ANTENNAS FOR SAILING CRAFT

Antenna systems installed on sailing vessels present unusual problems for medium-frequency radiotelephone communications. The techniques described are applicable also to other objects having extensive superstructure.

THE design of medium-frequency transmitting antennas that will function in the maze of masts and rigging of a pleasure sailboat is one of the most difficult problems facing the marine electronics engineer.

Three methods of attack have been found to be effective; insulate, isolate or incorporate. The one to use will depend upon the rig of the boat—whether sloop or schooner, &c., upon whether the rigging is inboard or outboard and upon the existence of open areas that will not be interfered with by the working of the booms and sails.

The transmitters are designed to operate directly into capacitive (shorter than quarter-wave-length) antennas having resistances from 3 to 100 ohms. Maximum communication range is desired. Circumstances may require spanning several hundred miles with less than 100 watts of power. Since vessel's headings may be any point of the compass, the antenna radiation pattern should be as omnidirectional as possible.

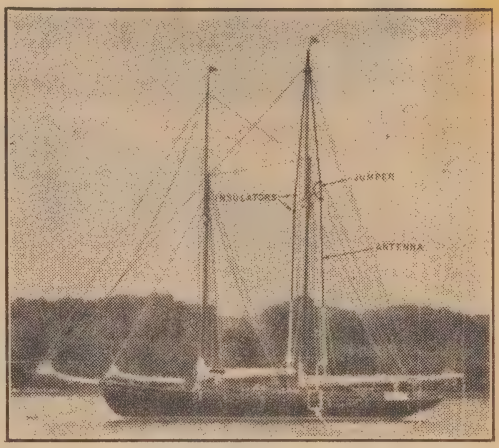

Fig. 1. An efficient antenna system is installed on the schooner Sea Gypsy with little alteration to the rigging. Main alteration aloft is to break shrouds and insulate with 20,000 lb porcelain compression insulators.

EXISTING WIRES

A proper selection of rigging wires themselves can be bonded and used as a broadband radiator. High frequencies can be accommodated through harmonic operation and the lowest marine frequencies can be reached by using a suitable loading coil. The installation illustrated (Figure 1) on the schooner *Sea Gypsy* shows how the principle may be applied.

When the vessel is under way there is no clear space aloft in which an antenna could be hung so as not to interefere with sails, rigging or booms at some point of sailing. Yet a permanently installed and highly efficient antenna was an absolute requirement due to the extended voyaging of the vessel. The only practical solution was to insulate part of the rigging for use as an antenna. The outer main shroud on the port side was chosen.

Layout of the vessel permitted installation of the transmitting equipment in the main cabin almost under the foot of the shroud. Allowing 20 feet for lead in and ground connection left 65 feet required to make up the optimum length.

Shipyard riggers removed each of the 7/8in steel-cable shrouds one at a time and eye spliced a 20,000lb porcelain compression insulator into each end. Twenty feet of the upper and 42 feet of the port main shroud were then bonded by a 3ft phosphor-bronze jumper. Remaining main shrouds were insulated similarly but not connected.

INTERFERENCE EFFECTS

The remaining rigging was of such a length or occupied such an angle that it did not interfere seriously. During subsequent cruises of the vessel no directional effects were noted and successful communications at extreme ranges were common. The New York marine operator could easily be reached from as far away as Trinidad with the vessel's 75 watts.

On most vessels extensive alterations to the rigging cannot be made. At the most, only one wire may be broken with insulators. Using one of the shrouds for an antenna with the remainder of the shrouds not insulated results in excessive absorption and variable loading as adjacent wires move or work.

With vessels having a standing backstay, the backstay is usually isolated enough to be insulated top and bottom and this makes an effective radiator.

The upper insulator must be placed so it does not foul the boom lift and the lower insulator must be kept as close to the turnbuckle or transom fitting as possible. Care must be taken that the lead-in insulator is not a physical hazard to the crew, that it will not snag sheets or lie in water on one tack.

Overall length of antenna and lead-in should not exceed the optimum figure. Capacitive loading often reduces the usable length to the neighborhood of 65ft instead of the free-space value of 85ft.

Even if antenna length is ideal, there are several disadvantages to the simplest utilisation of the backstay some of which can greatly reduce both the efficiency and reliability of the equipment.

TYPICAL CASE

The sail plan of the *Eventide* Figure 3, illustrates the important points. The normal location of the radio-telephone transmitter would be in the main cabin near the mast or in the dog house further aft. The lead-in from the bottom of the backstay to the equipment would be in excess of 25ft. A low-level horizontal run with the high-current portion of a Marconi antenna is undesirable under the best conditions. On a boat this horizontal run may be below the waterline and at best is surrounded by soggy wood and other wiring. It must pass directly by the auxiliary propulsion engine, picking up noise which may obliterate all signals.

From the standpoint of antenna efficiency, the transmitter should be as far aft as possible. In the *Eventide*, dry space was provided in a locker at the stern of the cockpit. The equipment can be operated from on deck or with a remote-control unit from the cabin.

On some vessels an ideally isolated wire may exist, but it may be located at such a distance that directly-connected antenna circuit

Fig. 2. Racing schooner Mistress uses permanently rigged antenna near lower main shrouds.

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Frequency Response: Power plus minus 0.5db, 10 c/s to 20,000 c/s.

Sensitivity: An input of 50mV to the first valve gives 10W output. This output is produced by an input of 600mV to the tone control circuit.

Pick-up: As supplied with normal control panel, the voltage output of the pick-up should be at least 0.5 volts to obtain specified output. A special Pre-Amplifier is available for low-level magnetic and moving coil pick-up units.

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cannot be used. An excellent example is the 110ft steel-hulled yacht *Mercury V*. The area above the main backstay was sufficiently in the clear for hanging an antenna which gave excellent performance. However, to reach the radiotelephone equipment which was installed in the main cabin near the mainmast a 75ft lead-in was required.

To avoid the extreme loss which would have resulted in running the first half of the antenna through the steel hull, the transmitter was altered to feed a low-impedance coaxial line using standard fittings and RG-8/U cable. The antenna-loading coil was removed and output taken from the antenna-coupling taps in the tank circuit.

MATCHING NETWORK

At the base of the antenna, inside the hull and just forward of the mizzenmast, a line-to-antenna-matching and antenna-resonating network was installed. The proper amount of inductance for antenna resonance on each channel was chosen by a relay actuated by voltage provided by the rewired transmitter antenna-tuning switch and fed aft by a multiconductor control cable. A telephone-talking circuit to aid in tuning was also provided in the control cable. The system is shown in Figure 4.

In other vessels of approximately the same layout it has been possible to obtain almost equal results with only one relay in the antenna-tuning unit since the marine transmitting frequencies are roughly divided into two groups—one around 2.6 Mc and the other around 2.1 Mc. Two compromise adjustments will give satisfactory operation over the two frequency ranges in any antenna of reasonable proportions.

SINGLE CABLE

This simplification permits the use of only one cable between transmitter and antenna-tuner unit by separating RF and DC circuits with chokes and capacitors, the DC current for the tuning relay can be supplied through the RF transmission cable.

A further possibility in this direction is the use of a saturable reactor for remote antenna tuning. Direct current for operation of the reactor can be provided through the RF line.

Attractive, but usually impractical is the often-projected use of the top stay between mastheads of larger vessels. Unfortunately, there is the problem of getting power to the antenna without excessive loss as in the case of backstay antennas. In addition, such wires aloft cannot be worked against ground except through the use of a half-wave ground line which adds tuning complications. Work on scale models shows upper stays can be used when use of loading coils or a counterpoise transforms the antenna to a half-wave system which can be fed by a non-radiating coaxial line. The same tuning arrangements as illustrated in the case of the *Mercury V* are applicable.

On the ocean-going schooner *Mistress* adequate coverage was obtained with an antenna permanently rigged near the lower main shrouds from deck level to a spreader tip. See Figure 5. By bringing the base end of the antenna inboard with the wire at the greatest angle to the shrouds, intercoupling was low enough for satisfactory operation.

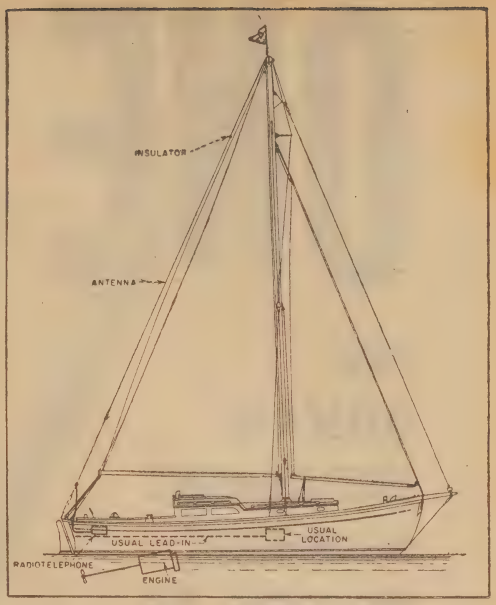

Fig. 3. Auxiliary cruising sloop Eventide uses insulated backstay as antenna radiator.

On some vessels it is desirable to incorporate the standing rigging into the antenna system. With the entire structure aloft acting as a radiator, shadows are entirely eliminated. Using the configuration of a fat folded monopole permits the use of the standing rigging without the introduction of insulators and requires only the bonding aloft and the grounding at the bottom of the main rigging elements. The folded form of fat monopole may be fed by one or more wires arranged to control the feed impedance. Advantages to be gained are: more uniform directivity; decreased ground loss due to the impedance step up of the form; and automatic lightning protection.

BROAD BAND EFFECT

In contrast to antenna consisting of one thin conductor, the fat form described by the usual sailboat rig has broadband characteristics which in some cases may equal the folded fan antenna frequency range of 4 to 1. Approximate low-frequency cutoff length is 142/frequency in Mc The rigging of a vessel with a mast height of 65 feet should be adaptable for incorporation in a folded antenna that will cover not only the medium-frequency marine channels but also most high-frequency long-distance bands.

SIZE OF CONDUCTOR

In the usual folded-antenna design, a fairly strict relation exists between the size and number of conductors and the impedance step up. However, due to the irregularities inherent in the many various boat rigs, the number of conductors in the system is not as convenient a gauge as the area described by the conductors.

Figure 5 illustrates measurements made on a system of this design. If the transmitter can accommodate a fairly high resistance nonreactive load it is possible to feed a folded system with one conductor of reasonably large cross section.

The fact that the usual marine radiotelephone has a limited output-impedance range does not prevent the use of this form of antenna. By increasing the effective

(Continued on Page 115)

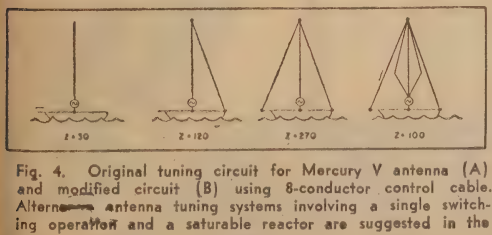

Fig. 4. Original tuning circuit for Mercury V antenna (A) and modified circuit (B) using 8-conductor control cable. Alternate antenna tuning systems involving a single switching operation and a saturable reactor are suggested in the text.

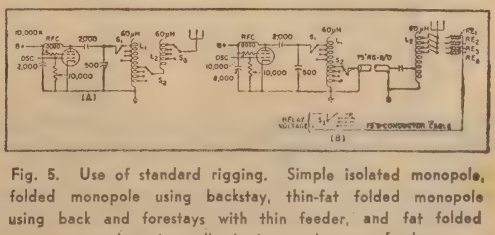

Fig. 5. Use of standard rigging. Simple isolated monopole, folded monopole using backstay, thin-fat folded monopole using back and forestays with thin feeder, and fat folded monopole using all rigging and cage feeder.

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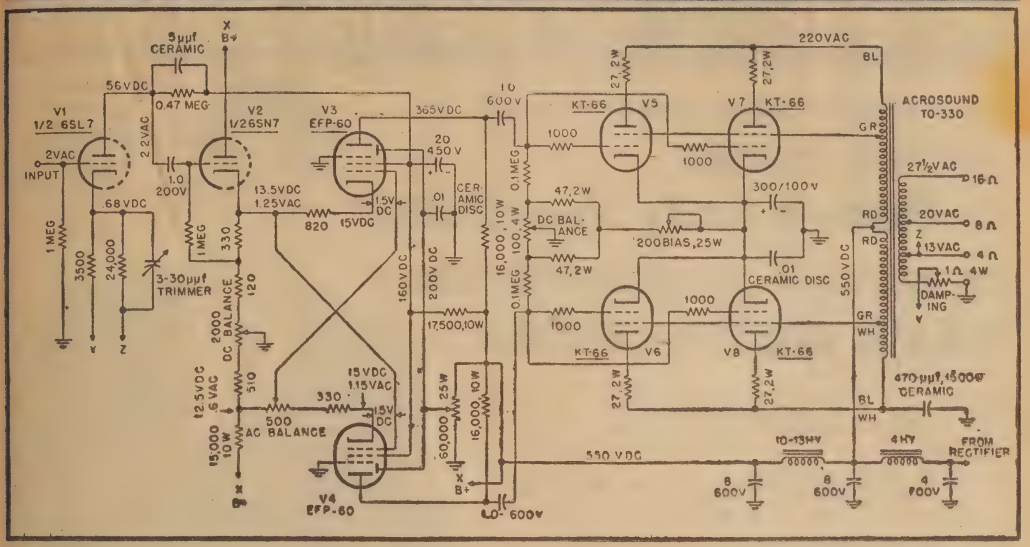

Another contribution to the search for more power, lower distortion and better listening quality. The circuit uses secondary emission tubes in a cross coupled phase splitter and four KT66's in the output stage.

An American experimenter, writing in Audio dated June, 1955, presents his design for a high power low distortion amplifier. Although certainly not for beginners, the amplifier is an interesting example of the lengths to which advanced individual constructors will go in search of the elusive ultimate in amplifier performance. A low impedance driver stage with high gain is obtained by using the Philips secondary emission valve type EFP-60.

ITS constructor, Mr. B. DePalma of the Massachusetts Institute of Technology, sets out his design requirements as follows:

(1) Negligible distortion — intermodulation, harmonic phase and frequency.

(2) No tendencies toward low-frequency or ultrasonic oscillations.

(3) A maximum power output far in excess of that required for the reproduction of the highest instantaneous peaks found in music.

(4) A negligible incremental output impedance and means for making this variable in a negative direction.

(5) Complete freedom from hum, hiss and microphonics.

The various circuit values were chosen experimentally for minimum measured intermodulation distortion before the application of feedback.

FEEDBACK TO INPUT

The input, at a level of up to 2 volts, is applied to a ½6SL7 used as a voltage amplifier with feedback introduced into the cathode circuit. The feedback has both voltage and current components. The former involves a capacitor which is adjusted to eliminate any tendency toward instability. The current component is variable down to zero giving a control over damping. Feedback is of the order of 30 db.

From the 6SL7 the signal passes on to a ½6SN7 operating as a cathode follower which provides a low impedance drive source for the EFP-60 cross coupled driver. Controls for both AC and DC balancing are provided in the driver circuit.

HIGH GM VALVE

The EFP-60 is a new and interesting type which employs the principle of secondary emission to obtain the extremely high transconductance of 25 mA/V. The voltage gain measures greater than 250 with only a 16,000 ohm plate load resistor. Thus a high voltage gain with low internal impedance suitable for driving the push-pull parallel power amplifier stage is obtained.

(We are informed that the EFP-60 is available in Australia.—Ed.)

The secondary cathodes of the EFP-60's are kept back at about 200 volts above ground by means of an adjustable divider network across the high tension supply.

The voltage should be set to zero when the amplifier is first switched on and then gradually increased until a sudden jump in value indicates that the secondary cathodes are operating. In the final lining up of the amplifier this voltage is adjusted for maximum gain when a secondary electron amplification factor of about 5 is available.

This output stage employs four KT66's in a push-pull parallel, partial triode arrangement. The position of the screen taps is not mentioned although the transformer type number is given.

The DC plate currents for the KT66's are balanced. The adjustment is important, as DC magnetisation of the output transformer core causes its low frequency characteristics to deteriorate badly.

LF RESPONSE

It is advisable to incorporate a high pass filter somewhere ahead of the amplifier, because the extended low frequency response, coupled with the fact that the output transformer power handling capacity drops off at the rate of 12 db per octave below 20 cps, makes the amplifier especially susceptible to overload below about 10 cps.

Record eccentricities, rumble, &c., may cause the output transformer to saturate at these extremely low frequencies, generating distortion and overloading the loudspeakers.

RESULTS

The quoted power and distortion figures are impressive. Harmonic distortion is less than 0.5 pc at 20 cps with 50 watts output. It decreases rapidly as the frequency is raised and is too small to be measured with certainty at 100 cps with 50 watts output. At no frequency between 100 cps and 20 Kc does the harmonic distortion exceed .05 pc at the 50 watt level.

The high tension supply requirements are by no means small—550 volts at 300 mA—and must be well regulated. Mr. DePalma used a pair of 5V4 rectifiers in his experimental power supply but the manufacturers' ratings for this type are exceeded in his design.

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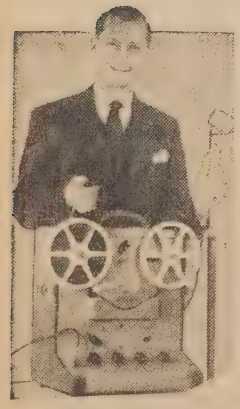

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NEWS AND VIEWS OF THE MONTH

Space travel "bilge"

THE new Astronomer-General of Britain has commenced his new duties with some plain words.

Speaking of interplanetary travel, he described it as "utter bilge".

Australians might catch the force of his description more accurately than did his English colleagues.

Professor Woolley recently resigned as Director of the Commonwealth Observatory, Mount Stromlo, Canberra.

On arrival in London, Professor Woolley said he was a "straightforward scientist".

On space travel he said, "I think it's all rather rot.

"I don't think any single government or groups of governments would put up enough money to do such a thing.

"Unless, of course, the next war could be won by the first chap going to the moon."

Space travel followers described Professor Woolley's statements as "unimaginative rot".

One of them was Kenneth Gatland, council member of the British Interplanetary Society and regarded as the brilliant young man in Britain's guided weapons and missile program.

He said, "Space travel is inevitable.

"It's bound to follow exploration of the upper atmosphere and the launching of artificial satellites during the International Geophysical Year.

"It's not a question of money.

"Man will always try to push forward horizons of knowledge."

Atom-powered plane

REPORTS that the U.S. Air Force has been flying an atom-powered bomber have been confirmed.

The air force said a B-36 intercontinental bomber had been fitted with an atomic reactor in the nose.

For the past month the B-36 had been flying over the south-west of Texas.

The air force made a joint announcement with the Convair Aircraft Company, of Fort Worth, Texas.

The announcement followed a report in the Albuquerque Journal, New Mexico, that a B-36 bomber had been flying over Texas, "possibly powered by an atomic reactor".

"The project includes a B-36 which carries an atomic reactor," the joint statement said.

"Among other things, the reactor is used to investigate problems of shielding against radiation, to study effects of radiation on aircraft, materials, and systems, and to develop air-borne nuclear instruments."

The statement added:

"The air force and Convair have carefully reviewed problems of hazard which might be involved in the tests, and have taken every precaution for public safety.

"The reactor is never operated during take-offs and landings.

"It is operated only when the aircraft is flying over a predesignated area where maximum public safety is attainable.

"Precautions taken also include informing local public officials throughout the area concerning public safety measures to be taken in the unlikely event of an accident."

The Dallas News said that the bomber was escorted by a C-97 carrying paratroopers.

The C-97 served a twin purpose —to wave off any other aircraft approaching the B-36 and to drop the paratroopers to seal off the area in case the B-36 crashed.

This news is of vital importance to aviation, both military and civil.

It illustrates once again how near we are to a complete revolution in our concepts of attack and defence.

The implications of large, nuclear-powered civil aircraft are equally great.

Atom-bomb replies

THE United States is reported to have atom-bombers in the air day and night, ready for action in the event of an enemy attack.

They could be taking atom-bombs overseas within an hour.

The airborne planes—hundreds of them—are supplementary to others on the ground.

In the event of attack, they would fly to widely scattered bases, pick up nuclear bombs, and head overseas.

It is reported that Russia's production of long-range jet bombers now almost equals America's.

Known in the West as Bison, these bombers can carry hydrogen

POPULAR SCIENCE QUIZ

Q.: What is a Rolligon?

A.: The Rolligon tyre, intended to allow vehicles to operate under a much wider set of road conditions, than at present, spreads the weight of its load evenly over a larger area than is possible with conventional tyres.

A Rolligon tyre is actually a huge rubber bag, about the shape of a doughnut, inflated only sufficiently to hold its shape. A shaft passes through the centre hole, but it is used only to keep the bag in place, and it does not carry any load.

The load is transmitted to the bag by a series of rollers on the underside of the vehicle. These rollers are driven from the engine, and actually roll the bag under themselves.

The large, soft surface area of the Rolligon bags distributes the load evenly, and allows the vehicle to travel over almost any surface, soft or rough.

In fact it can be said that only a vertical wall will stop a Rolligon.

At the moment its only drawback is low speed, but engineers are predicting that faster models will soon take to the road.

Q.: What is a radioautograph?

A.: Radioactive materials give off a strong radiation, very similar to x-rays. This radiation affects photographic films in the same way as do x-rays. It blackens the emulsion according to the intensity of the radiation.

If a piece of material containing radioactive elements is placed on a photographic plate in a light-tight container, the radiation from it will penetrate the container and produce an image of the material on the plate. This image, recording the distribution of radioactivity in the sample, is called a radioautograph. The word is derived from the Greek, meaning "an image of oneself".

Q.: What is a moderator used for?

A.: Neutrons released by naturally radioactive materials collide with atoms around them, effecting fission of further atoms, and releasing more neutrons. If there is a sufficient number of atoms capable of being split, a chain reaction sets in, and ultimately the whole of the material disintegrates, releasing a tremendous amount of energy.

This happens in each case, unless special precautions are taken. It is usual, therefore, to insert into the fissionable material rods of special elements to absorb a certain number of neutrons. These slow the chain reaction to a safe speed. The rods are made of beryllium pure graphite or aluminium cans containing heavy water, and are called moderators.

Q.: What is the Half-Value Period?

A.: Radioactivity is the disintegration of atomic nuclei. The nucleus usually splits into two, liberating one or more neutrons in the process. The two parts of the nucleus form nuclei for two stable elements, which do not split further. Thus in time the whole of the fissionable nuclei in a sample split and the sample ceases to be radioactive. The time in which exactly half the nuclei disintegrate, thus reducing the radioactivity of the sample by 50 pc, is called the half-value period, or alternatively, the half-life, or period of decay, of the radioactive element.

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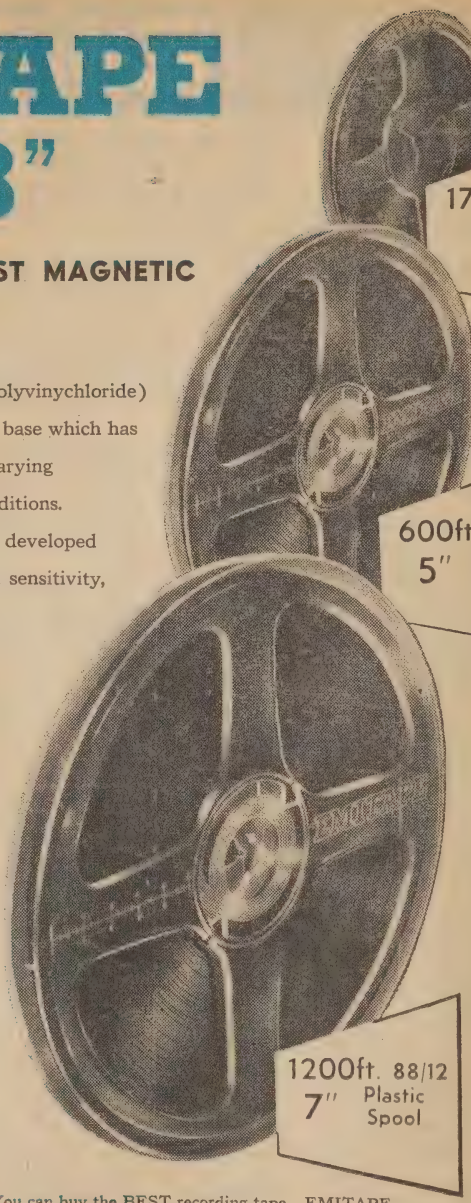

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bombs to any American target, but lack the range to return to Russia.

Their production rate is now 120 a year, and by the end of the year it should reach about 200 a year.

Planes gather dust

SPECIALLY equipped Canberra jet planes will collect atomic cloud samples after Britain's atomic tests in the Monte Bello Islands in April.

More than 20 RAF aircraft and others from the RAAF will take part in the Monte Bello operation.

This is the first time a big air task force has been assembled for a British atomic test.

The Minister for Supply (Mr. Beale) gave these details of the task force work:

Canberras operating from Pearce Field would collect cloud samples and make photographic flights.

Aircraft and helicopters would make low level radiological surveys, undertake vertical photography over the explosion area and maintain air communications between the mainland and the islands.

Neptune aircraft would carry out safety patrols to ensure that ships were not in the danger area at the time of the explosions.

Shackleton aircraft would fly each day over the Timor area from Darwin from mid-February to watch for tropical storms.

An automotive future

THE next industrial revolution might well be that of automatic industrial processes, known briefly as automation.

Specially applicable to mass production, automatically controlled machines, once set in motion, can continue to function until they fall to pieces. They can even be made to repair themselves and to effect replacements when parts wear out.

Under these conditions, there is very little for men to do other than to fill and empty the "inwards" and "outwards".

Automatic industrial processes (automation) might bring about a four-day week within 10 years, said Dr. James L. Stern, staff consultant of the United Automobile Workers' Automation Committee.

Automation might bring also a 20 pc rise in individual income.

Recently he told the American Association for the Advancement of Science that automation would:—

Allow people to retire earlier on adequate pensions.

Allow children to stay in school longer to receive the training the society of tomorrow would need.

"For the first time in the history of man we have reached the stage where our scientific prowess has provided the tools for the abolition of poverty," Dr. Stern said.

The main problem will be maintenance of full employment.

"If we fail to solve it the social implications of automation will be 'solved' in surplus goods going to waste while unemployed people go hungry."

Dr. Lillian M. Gilbreth, an industry consultant, warned the association than the "human relations" aspect of automation needed consideration.

"Automation provides a special challenge to the engineer," Dr. Gilbreth declared.

"He must prepare to meet this challenge by getting ready to carry out more fully the obligations of his code.

"He must plan to use the resources of nature and human nature for the benefit of mankind."

Aluminium solder

TILTMAN LANGLEY, English research and development consultants, have evolved a new method of soldering aluminium which is expected to be of value to the aircraft industry.

Present soft soldering technique usually relies on heavy and expensive soldering tools mechanically or electronically operated. Solder consisting of 90 pc tin and 10 pc zinc alloy is commonly used.

Tiltman Langley has developed a soldering tool in the form of a small brush that is capable of being used for the fluxless soldering of aluminium with any normal solder.

The technique involves the use of an electric hot-plate to raise the work to the required temperature. The solder is applied and the surface is lightly scoured with the brush, made of glass fibres, until the area is effectively overlaid. The surfaces to be joined are placed together and a neat fillet of solder produced by sweeping through the molten solder with the brush.

Japs ban atom war

JAPAN has banned even the study of atomic energy for military use.

A new law firmly states that there "can be no military use of atomic energy in this country".

Japan's new Atomic Energy Commission will decide practically all important matters about the use of atomic energy.

The law stipulates that decisions made by the commission should be respected by the Premier.

The Government also plans to set up two public corporations and a scientific and technological board.

The Nuclear Fuel Corporation will be the government agency to prospect for, mine, refine and control uranium and thorium.

The other corporation will be a research and development corporation.

Some leading private corporations have already formed study committees and announced plans for active research.

These studies are also to be under State supervision to prevent research from being directed into "undesirable channels".

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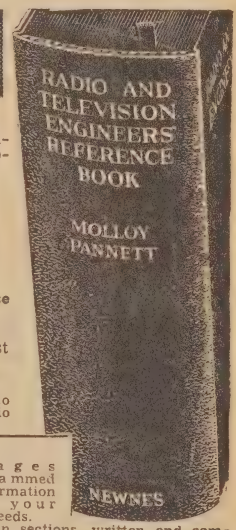

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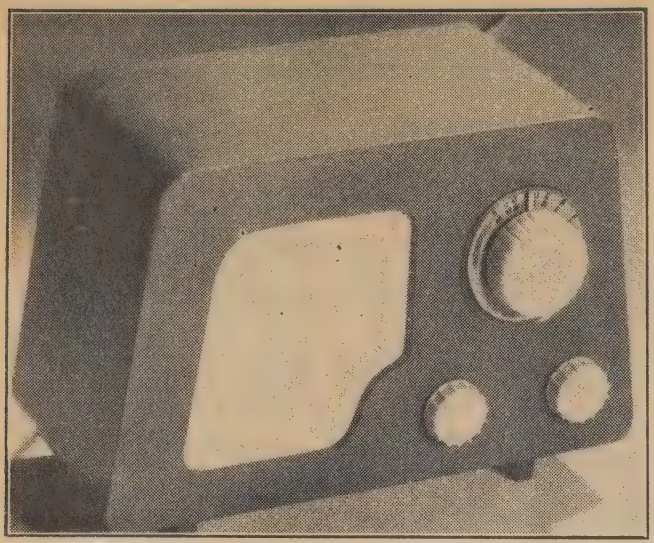


The finished set in its attractive cabinet. The main tuning dial is easily identified and below left is the volume control and power switch. The regeneration control is on the right. In many cases no external aerial will be necessary.

A NEW BABY MANTEL RECEIVER

Here is a set designed essentially for our younger class of readers, the teenage schoolboy who wants to make something more impressive than a crystal or one valve set. Although simple to build and having no critical adjustments, it has a first class performance and very attractive appearance.

CRYSTAL sets and one and two valve sets are all right in their way, jolly good fun to build and excellent training for the raw novice. But after that—what next? Sooner or later the beginner hankers after something more ambitious; something that performs like a full size set.

But it is a big step from such small beginnings to, say, a four valve mantel set, and many of our younger readers hesitate to take it all at once. For one thing, there is the question of finance, and for another, the problem of alignment of the finished set. When these facts are considered along with the generally more complex nature of the job, the overall picture can be rather frightening.

EASIER STEP

This is where our present set is intended to fit in. It is an AC receiver with a much higher order of performance than the simple headphone sets, yet so much simpler in design than a four valve superhet that anyone with a little previous experience should have no difficulty in building it.

A particularly attractive feature is the self contained aerial. This should give quite adequate pickup in most of the inner suburbs. In less favorable districts, a few feet of aerial should be sufficient to bring in the locals, and provision is made to connect such an aerial if it is wanted.

It has a larger (four inch) speaker than most sets of its size and, like its bigger brothers, a neat, slow motion, calibrated dial, a regular volume control, and a self contained power switch as part of the control. Altogether it is an ideal design for the budding home builder.

And you won't have to apologise for its appearance, either. Housed in a smart cabinet of contemporary design, it will be just as acceptable in the lounge room as on your own bedside table.

In fact, it's our bet that the biggest trouble you will have with this set will be keeping it away from Mum and Dad and the rest of the family!

by Philip Watson

In more specific terms, there are several points about the design worth discussing. One of the most important is the use of the loopstick in a set of this type. It was inspired by our experience with the Loopstick One (July, 1954) and which put up a very impressive performance for a one valve set.

When we considered this performance and the fact that many stations have recently increased their power by worthwhile amounts, it seemed reasonable to expect something pretty good from a loopstick used in conjunction with two high gain valves.

We were not disappointed. Tested in a none-too-favorable spot on the Illawarra line, it did very well. Without an auxiliary aerial of any kind, it brought in all the local stations. Six were excellent entertainment strength, the remaining two being readable but rather on the weak side. 2WL Wollongong could also be heard, in daylight, though too weak to be of any value. Nevertheless, the fact that it was audible at all gives some idea of the set's performance.

The selectivity is also better than normal for sets of this type. This is due to the naturally high Q of the loopstick. To check this, we tried the set in a quite different locality in close proximity to several local transmitters. It had no difficulty in separating them all.

To provide the highest possible gain, we chose the 6AU6 as a regenerative detector, followed by a 6BV7 as an output stage. This combination would be hard to beat for overall gain. The rectifier is a 6X4.

MODERATE HT

Adequate power output for a set of this type can be obtained from the 6BV7 with quite a moderate HT voltage. This permits a smaller power transformer with advantages of lower cost, less space and cooler running. The transformer is a 150 volt 30 mA type with a single 6.3 filament winding.

The lower voltage permits the use of 350 volt electrolytics and the small current drain is easily handled by a 50 mA, 12 henry choke. Altogether, the power supply components can be accommodated in a very small space.

Regeneration is provided by fitting an extra winding to the loopstick (more details in a moment) and is controlled by means of a 100 pf

riable capacitor. One feature of e loopstick when used in this way that the setting of the regenera-)n control remains remarkably nstant over the band and could rtainly be "pre-set" in high signal rength areas. This reduces the mber of controls to be adjusted two—tuning and volume, or the educible minimum.

The volume control is also useful other ways. It provides a power vitch which is almost essential if e set is to be used as a bedside mpanion. It also serves to con-)l the volume in those cases where, r reasons of selectivity, it might necessary to push the regenera-)n to maximum, even though this sults in a louder than necessary gnal.

ARGER SPEAKER

The new four-inch speakers are pable of better performance than e 3in types, yet can be accommo-ited quite conveniently in a set of is kind. If you have a 3in speaker hand, there is no reason why)u should not use it, allowing for me reduction in maximum power tput.

Finally, the use of one of the w planetary drives makes possible very neat and efficient dial in a nall space. With the high order selectivity possible with a regen-ative loopstick, a smooth working ow motion dial is essential for)od results.

All of which should give you a irly accurate picture of what the t will do and how the perform-ce was achieved. Now we come the actual construction.

A ready made chassis is half the attle in building any kind of set id more so if you are a beginner. 'e will prepare blueprints for the assis manufacturers and you ould be able to buy the chassis long with all the rest of the parts -preferably as a complete kit.

Start by mounting the larger com-onents such as the power trans-rmer and choke, tuning capacitor, eaction capacitor, and volume con-ol. It is a good idea to leave the peaker at this stage, apart from ecking that it will fit. With all e handling of the chassis that is ecessary, it is quite easy to put our finger or a screwdriver through e cone.

CORRECT ORDER

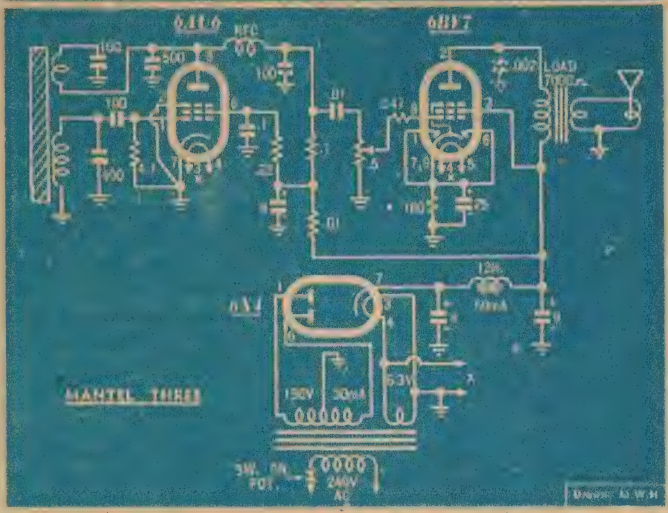
Fitting the choke and power ansformer will call for a little in-enuity, since they are mounted on pposite sides of the chassis, and t is necessary to use countersunk crews as indicated by suitable oles in the chassis. A few moments' hought will show that certain crews will have to be fitted in the ight order if the holes are not to e "built out" by one or other of hese components.

Rubber grommets should be in-erted in the two holes at the foot f the transformer and in the rear f the chassis. These are to pro-ect the power and transformer eads from any sharp metal edges.

The sockets should now be mount-d, taking care to orientate them s in the layout diagram. In the ase of the 6AU6 and the 6BV7 the centre shield should be earthed. This connection should be to solder lugs anchored under the socket mounting bolts and which should be joined together and to all other earth points by means of bare tinned copper wire. This is only necessary when a steel chassis is being used.

Three tag strips are used to support most of the minor components and a good idea of their position may be obtained from the layout diagram. The one nearest the end of the chassis is an eight terminal type from which one terminal (nearest the speaker) has been clipped off. It supports the first electrolytic and provides terminals for the incoming mains leads, the power transformer primary leads, and the leads to the switch section of the volume control.

CIRCUIT OF THE MANTEL THREE



The circuit is quite straightforward and simple enough for most beginners. The 6AU6 is a regenerative detector and the 6BV7 the output stage. Note the loopstick aerial and the regeneration circuit.

The five terminal strip at the opposite end of the chassis serves mainly to terminate the leads from the loopstick. It also supports the 500 pf mica capacitor and one end of the 100 pf grid capacitor.

The third tag strip supports the .01 meg. decoupling resistor, the .1 meg. plate load resistor, the 100 pf RF by-pass, and one end each of the RF choke, the .22 meg. screen resistor, and the .01 mfd coupling capacitor. The other components are self supporting between their respective points in the circuit.

It should be safe to fit the speaker at this stage and then the wiring can be commenced. Plastic covered hookup wire is used throughout, except that much of the wiring can be done with the component pigtails.

The wiring is not particularly dif-

PARTS LIST

1 Chassis 7¾in x 4in x 1¾in.
1 Power transformer 150V 30mA.
1 Choke 50mA. 12H.
1 4in speaker.
1 Speaker transformer 7000 ohms suit above (LCG72 or similar).
1 Planetary drive No. 2 type.
1 Loopstick.
1 Dial transfer (suit state).

VALVES

1 6AU6, 1 6BV7, 1 6X4

RESISTORS

1 4.7 meg. ½W.
1 .5 meg. pot with switch.
1 .22 meg. ½W.
1 .1 meg. ½W.
1 .047 meg. ½W.
1 .01 meg. 1W.
1 180 ohm 1W.

CAPACITORS

1 25 mfd 40V electrolytic.
3 8 mfd 350V electrolytics.
1 .1 mfd 200V paper.
1 .01 mfd 200V paper.
1 500 pf mica.
1 400 pf single section midget tuning capacitor.
1 100 pf variable reaction capacitor.
1 100 pf ceramic.
1 100 pf mica.
1 9 pin valve socket.
2 7 pin miniature valve sockets.
1 4 section RF choke
1 8 terminal tag strip.
1 7 terminal tag strip.
1 5 terminal tag strip.
2 Medium knobs.
1 Large knob.
3 Grommets, hookup wire, tinned copper wire, nuts and bolts, solder lugs, etc.

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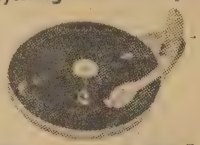

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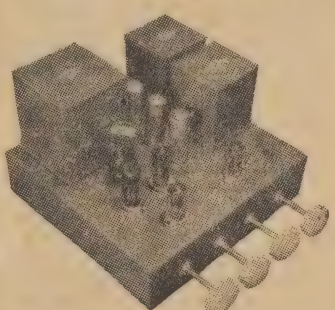

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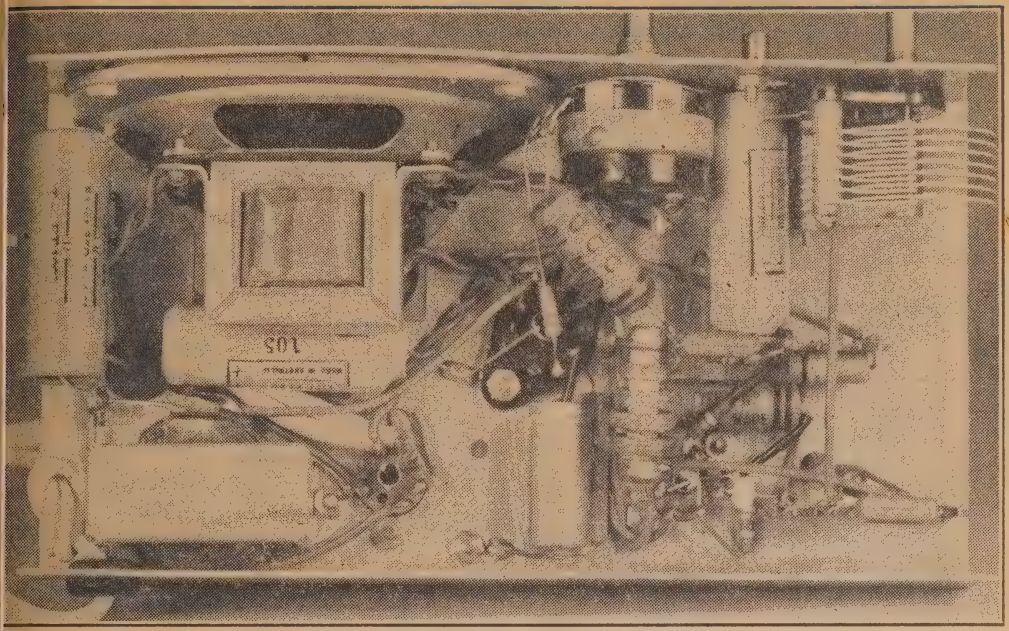
UNDERCHASSIS VIEW SHOWS MAJOR COMPONENTS



This picture, used in conjunction with the layout diagram, should give a good idea of the construction. The 6BV7 socket is almost exactly central. Bottom left is the power choke, above it the speaker and its transformer and to the right of this the volume control. The regeneration capacitor is on the extreme right.

cult and anyone with a little experience in building smaller sets ıould have no difficulty in followıg the circuit. With the layout iagram to show where each comonent is to be mounted, all should e plain sailing.

You will find four terminals on ıe back of the volume control and ach pair is a separate switch sec-on. We need only one pair and ither will do. It only remains to ientify which two make a pair. You an do this with any form of simple ontinuity meter, such as a battery nd torch globe or buzzer.

Since loopsticks are not normally tted with a regeneration winding, ve have to fit our own. This is not ifficult and is helped by the fact ıat the coupling between the two vindings is easily adjusted, so that he exact number of turns is not ritical.

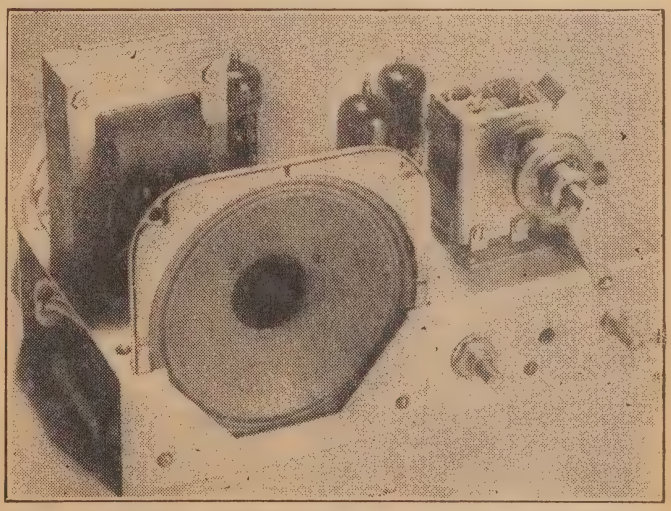
SUITABLE WIRE

The best scheme appears to be o wind the coil with a short length f very fine hookup wire, such as /.0076. This is fine enough to make neat coil yet rugged enough to erve as connecting leads as well. bout eight turns will be sufficient nd even then it may have to be et a couple of inches from the grid vinding.

We wound our coil over three arrow strips of sticky tape laid engthwise on the loopstick, sticky ide out. (You may need an extra air of hands at this stage.) The engths of tape should be about three times as long as the winding, the latter being wound over the centre "third".

When the winding is complete the free ends can be folded over the top of it and will hold the winding quite firm. Don't make the winding too tight or you may have difficulty adjusting it on the rod.

A word of warning: These rods are very brittle and can be quite easily snapped by dropping them only a few inches if conditions happen to be just right (or wrong!).



A front view of the chassis, showing major components. The 6BV7 is directly behind the speaker, the 6AU6 to the right and the 6X4 near the transformer. Note the planetary drive on the tuning capacitor and the collar to take the pointer.

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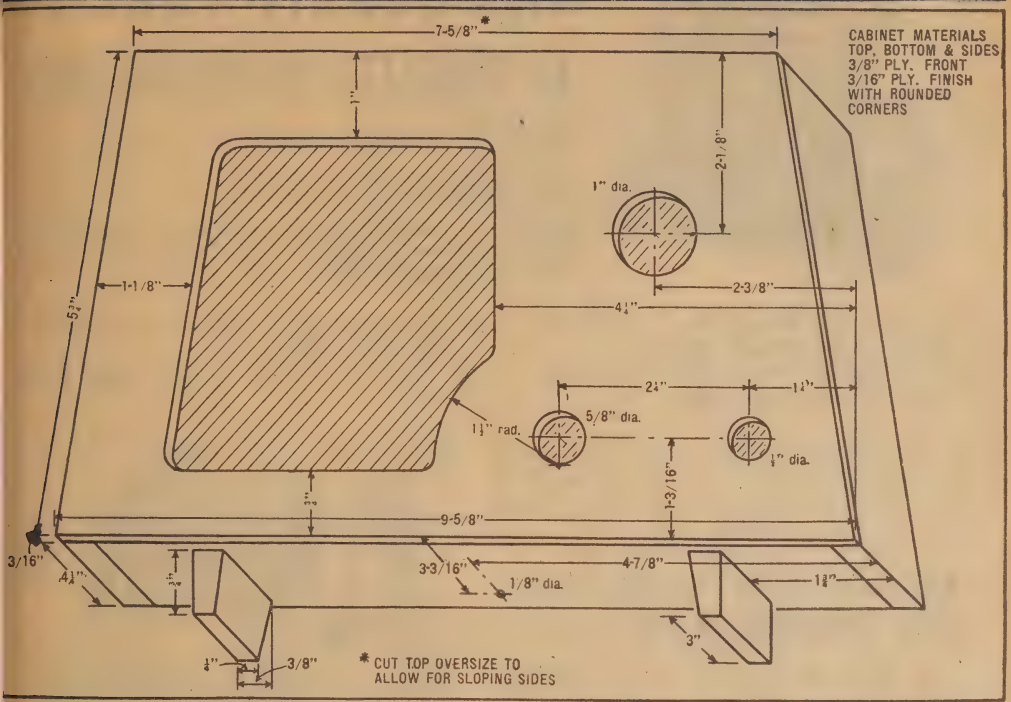
MAKE YOUR OWN CABINET FROM THIS DRAWING

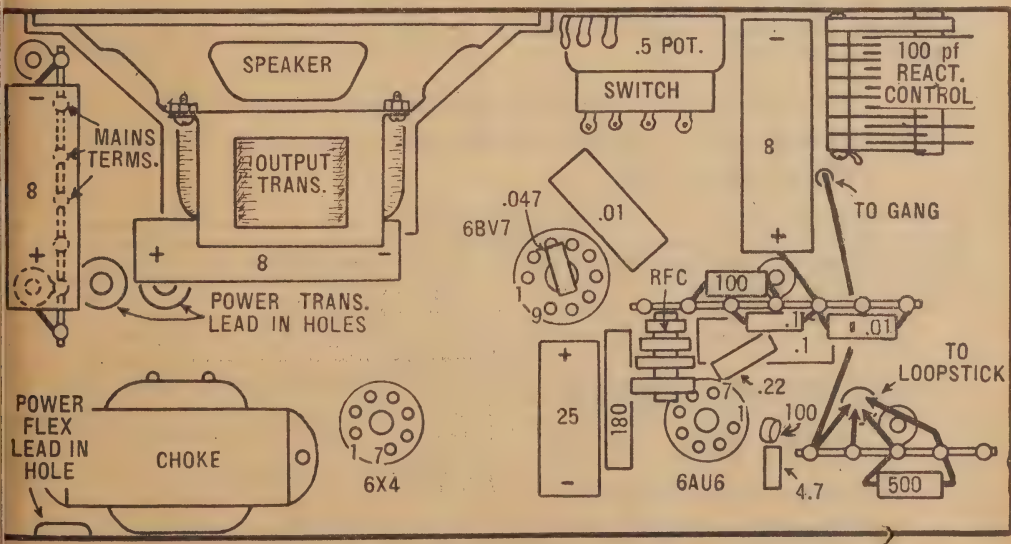


This drawing contains all the details to enable you to make your own attractive cabinet. Note that the corners should be rounded as much as possible consistent with strength. Finish may be glossy lacquer in any selected color.

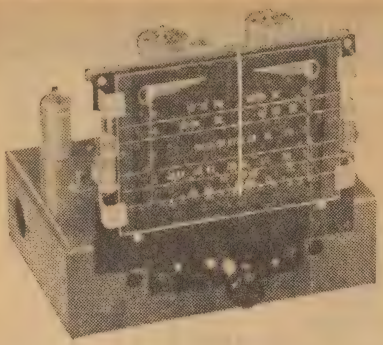
Treat them much as you would a rod of glass.

It is a 50-50 chance whether your winding will be correctly phased for regeneration or not. If the set cannot be made to oscillate with a reasonable order of coupling to the grid winding, slip it off the rod, turn it over, and put it back on again. Adjust the coupling until regeneration is obtained with the capacitor about half way in or a little more.

As already mentioned, the setting of this control will be fairly con-



This layout diagram shows clearly where each component is mounted. Study it in conjunction wtih the underchassis photograph and the circuit diagram. Note the orientation of the valve sockets and the location of the tag strips.



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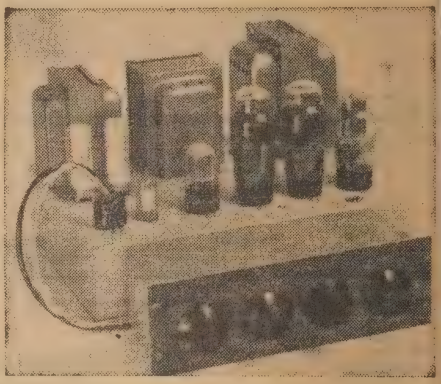

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ant over the band. This means at a smaller type may be used if ecessary. We tried a 7-plate type bout 50 pf) and this was quite ccessful. It is likely that even naller types could be used in an nergency. In such cases the coupg between windings will have to increased slightly.

Smooth regeneration is essential the successful working of any t of this type and we have selected e component values very carefully ith this point in mind. Regenera-n should come about quite gradu-ly and smoothly as the control is ivanced. It should go into and t of oscillation at the same point. ny suggestion of "plop" in the tion will ruin the proper perform-nce.

F BY-PASSES

RF which finds its way into the 3V7 plate circuit can upset the generation and we have provided enty of RF by-passes in the de-ctor plate circuit to guard against is. However, if it should appear be present it may be necessary fit the .002 mfd plate by-pass own dotted in the circuit. Normly, it should not be necessary.

In localities where all local sta-ons cannot be received on the opstick it is quite easy to fit an ternal aerial. Often only a few et of wire will be necessary and n easily be a length of hookup ire. A few turns around the rod ar the grid coil should provide fficient coupling and a permanent inding similar to the reaction inding could be fitted. Earthing e free end of the winding to chas-s should give best results.

Loopsticks need to be mounted rizontally and the length (about n) presented a problem in cabinet sign. Housed in the normal way, would have called for a cabinet least 8in long (inside) at the top. his was much larger than necesry to accommodate the set, but we ially solved the problem by mount-g it diagonally.

OUNTING POSITION

Looking at the front of the binet, it runs from the front left nd corner to the rear right hand rner. There is about ¼in clear-nce to the inside top of the cabinet. the front corner it is held by a nall triangular block of wood, uitably shaped to fit the sloping de of the cabinet, and having a ightly oversize hole into which the d slips easily. Glue alone should strong enough to hold this wood ock.

At the rear corner a small chan-l is cut on the inner face of the binet side and which accommo-ates the other end of the rod. It about two layers of ply deep, pproximately ¼in long, and as ide as the rod. It is most easily it with the point of a sharp knife nd the wood removed a layer at a me. After the rod is fitted a rrow strip of wood may be tacked ghtly across this channel to hold in place.

There are two styles of planetary ive readily available at the pre-nt time, both by the same manu-cturer, and designated as type e and type two. We used the o. 2 design, which has a reducing ush to permit its use with a ¼in ng shaft (as in this case) and a

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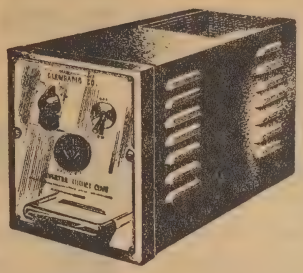
240 VOLT AC 50 CYCLE INVERTERS



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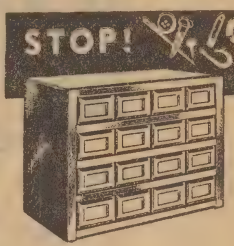

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5-Valve Kloxette . . . . (p.64)

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4-Channel Mixer Unit (p. 48)
A Basic 5-Valve Receiver (p. 64)

JANUARY ISSUE
VT Voltmeter . . . . (p. 5
Multi-Band Receiver (p. 4
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FEBRUARY ISSUE
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We supply the parts, but cannot enter into any technical correspondence.

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llar to facilitate fitting the pointer.

The collar is tapped and fitted ith three small cheese head screws. iese may be used to hold small lluloid or perspex pointer similar that used in the Kloxette. We ose a somewhat simpler scheme d one which we think will appeal mostt builders. The pointer is nply a short length of 18 gauge ned copper wire, held by form- g it into a small loop around one the cheese head screws. A short ece of 1 mill white plastic tubing ped over it gives it an attrac- e appearance.

The mounting position of the ng is such that the front of the llar should just show through the ont of the cabinet, allowing enough earance for the pointer. There is om for some adjustment and the ng shaft can be shortened slightly necessary.

AL TRANSFER

The dial is a simple transfer type d is supplied as a disc of cellu- id and a paper based transfer. ak the transfer in water until the ttern shows obvious signs of slip- ng from the paper base. When is quite free, place the disc over e top of it, centre it carefully, d slide away the backing. Smooth t any wrinkles by rolling with a ncil or stroking carefully under a ece of paper. Smooth from the ntre to the outside.

Allow time to dry before hand- ng and then mount by means of o small panel pins in the positions dicated on the dial. The large ob hides most of the dial apart om the station markings, and only short length of the pointer need visible.

To make the dial track correctly ith the station markings, it will necessary to adjust the tuned rcuit at both the high and low equency ends of the band. For- nately this is quite simple.

First make sure that, with the ng fully closed, the pointer cor- sponds with the set mark on the treme right of the dial. It may necessary to loosen the collar ub screws and rotate the collar achieve this. When this is done, eck the position of a prominent w frequency station (say 2FC) and rrect its position by moving the id coil along the loopstick.

After this it will probably be cessary to adjust the position of e reaction coil again to maintain rrect coupling between the two ndings.

IGH FREQUENCY CHECK

Now check at the high frequency d (say 2SM), which will probably veal considerable error. Correc- on for this will call for a trimmer ross the tuning capacitor, some- ing a little unusual in a small set, it quite legitimate when a cali- ated dial is to be used. Without e trimmer, the tuning range is tended somewhat and will enable u to explore the region just be- w the broadcast band. This, of urse, at the expense of losing your al calibrations.

The chassis is held in the cabinet means of a single 1/8in screw rough the bottom of the cabinet

TELEVISION SCREEN ON THE HOOF

This TV set in London startled passers-by when it received programs while being carried by hand. It was connected by cable to the car battery.

and through a hole in the chassis between the 6X4 and the 6AU6. It will need to be at least 2-1/8in long.

For best results, the speaker should fit snugly against the front of the cabinet, but it will be necessary to make a small baffle to accomplish this. It may be made from thin plywood or thick cardboard. Corrugated board as used in cartons is very good and normally quite thick enough. It will have to be shaped roughly to allow for the thickness of the chassis in front of the lower part of the speaker.

Construction of the cabinet should not present any difficulties to anyone accustomed to simple woodwork. Readers still attending school may be able to make it as a project in their woodwork class. All the essential data is given in the accompanying drawing.

MATERIAL

Plywood is used throughout, 3/8in for the sides, top and bottom, and 3/16 for the front. The sides are fitted outside the top and bottom, which gives somewhat greater strength, and the joints are made with panel pins and glue. Cold water glues are quite satisfactory and very convenient where only a small amount of work is to be done. However, if "hide" glue is available and can be properly applied, it will make a very good job.

As can be seen from the photographs, the corners are rounded quite appreciably and this adds considerably to the finished appearance. The rounding may be done with a wood rasp, finishing off with fine glass paper. The only limit to the amount of round is the possible weakening of the corner if too much wood is removed.

FINISH

The finish can be according to your own personal taste. We chose a bright red glossy lacquer and this looks very attractive. Another suggestion is glossy black, preferably with a bright colored speaker silk to provide contrast. There are plenty of other combinations which will suggest themselves to the artistically minded.

Before lacquering, dress the wood down to the smoothest possible surface with fine glass or garnet paper. An undercoat is a good idea if you can manage it, and this may be dressed down in a similar manner when it is quite dry.

You will need at least two coats of the final color, perhaps three if no undercoat is used. Allow plenty of time for drying between coats, apply each coat carefully, and the final result should be very smart.

So there it is—you can make the whole thing, set and cabinet, and finish up with something of which you can be justly proud.

Go to it—and good luck!

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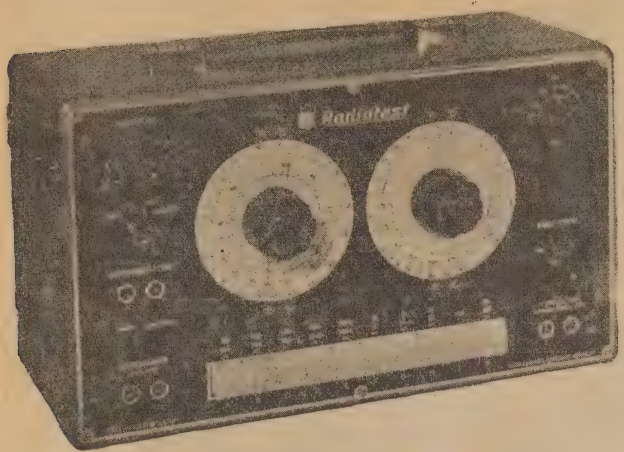

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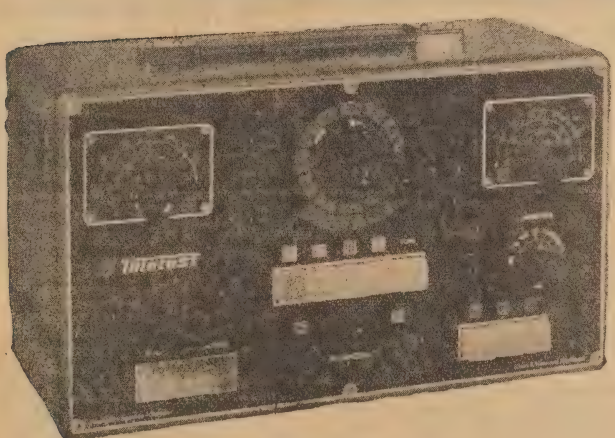

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Here's your answer, Tom!

Man-made lighting has been the stock-in-trade of museums and exhibitions for many years. Artificially induced rain has been very much in the news lately. So why not have artificial rainbows?

ERHAPS we are taking Tom too literally by introducing our icle this way but you'll under- nd why when you read Tom's t question.
Before you laugh, however, could u answer it yourself?

The other day I noticed in an overseas radio magazine a reference to a "Rainbow" generator. What on earth would this be?

Modern electronics has certainly oduced some peculiar instruments, m, and their names do not always close what those instruments are ed for. One of the most pic- resque names one can find is cer- nly that of the "rainbow" gener- r.
But you can rest assured that it es not generate rainbows, not in meteorological sense, anyway.

Copper or bronze?

The name was actually invented engineers (or somebody) work- g with American color television uipment.
You see, Tom, rainbow generators e akin to signal generators used servicing radio receivers, only ey work on different frequencies, ve a few more knobs on the front, d are a lot more complicated on e inside.
They generate a signal which is ed for the alignment of color TV ceivers, when there is no color ogram on the air. The signal — TV frequencies — contains the cessary pulses to produce a color- pattern on the screen of the re- iver. Naturally, this pattern does t show a photogenic redhead, but ly colored bars, or dots.
The idea is to feed a signal into e receiver under test, making the appropriate adjustments until the correct pattern appears on the screen. The pattern being colored, somebody somewhere called the color pattern generator — that's what the machine is — a "rainbow generator" and the name stuck.

The next question is somewhat more down to earth.

Why is copper not used in making chassis?

A quick look around any Australian beach on a sunny day would almost convince one, that it is indeed used for chassis — of a different kind! Or is it bronze?

Fun aside, Tom, there are very good reasons why copper is not commonly used for radio chassis, even though it has such good electrical characteristics.

First of all, copper is rather soft, certainly softer than steel, or even dural, and much less elastic. To make a chassis of sufficient strength, a correspondingly heavier gauge of copper sheet would be required.

Copper also has a higher specific weight than either steel or aluminium and the finished chassis would be extremely heavy.

Add to these disadvantages that of high cost and difficult soldering—copper conducts heat very rapidly, and you can see why the radio industry prefers to make chassis out of other materials.

Lacquered steel is commonly used for ordinary broadcast receivers and amplifiers, though some manufacturers use treated cadmium-plated steel.

Good quality tin-plate may be preferred for certain high-frequency equipment, its special advantage being ease of soldering. Aluminium —or some of its alloys —also have their advantages in such equipment.

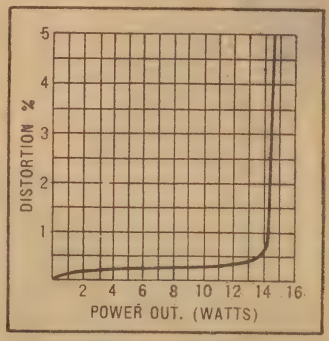
Copper and/or silver plated mild steel are further possibilities, with native brass and copper well down the list.

Is there any difference between crystal and magetic headphones?

All kinds of headphones have one thing in common: they are used to convert weak electrical signals into sound vibrations. They also have another common feature, a diaphragm, to transmit the vibrations to the air and thence to the eardrum.

The essential difference is in the way this diaphragm is set into motion. In the simplest type of headphone the diaphragm is made of soft steel and is held under constant tension by a small magnet. The magnet has small coils wound over its pole pieces, which produce a magnetic field when current flows in them.

This magnetic field aids, or opposes the magnetic field produced by the permanent magnet, according to the polarity of the current flowing through the coil and thus increases or decreases the tension on the diaphragm. If the current flowing through the coils is AC at audio frequencies, the diaphragm will move in accordance with the signal, thus producing audible sound.



Illustrating the rise in distortion which indicates the "overload" condition for an output valve.

In another type of magnetic headphone the diaphragm is made of some non-ferrous material, such as paper or aluminium, in the shape of a cone, and has a small coil attached at the apex.

This coil moves in a circular gap between the poles of a magnet, and the opposition or attraction of the magnetic field produced by the coil to the permanent magnetic field results in the required movement of the diaphragm. In other words we have a miniature dynamic loudspeaker.

Crystal phones operate on an entirely different principle, known as the "piezo-electric" effect. It is based on the fact that certain kinds of crystals, such as those of Rochelle salts, or quartz, change their shape if a potential is applied to two opposite sides.

In practical designs the diaphragm is attached by means of a small rod or wire to one corner of a square slab of crystal, the other three corners being fixed to the casing. On the application of a small voltage the crystal slab bends, moving the diaphragm with it, in accordance with applied voltage variations.

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And now to meet the needs of manufacturers, Rola has developed a whole series of the special types which are needed in television receivers. The design of these, too, reflects the skill and manufacturing precision associated with the Rola name.

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e advantage of crystal earphones hat they can be made very small l light, and consequently a lot ier to wear.

Electrically, the vital difference hat there is no DC circuit through m and they can not—and should —be wired directly in series with valve plate circuit. The plate cur- t must always be diverted through uitable resistor or choke, the audio tage only being conveyed to the stal phones through a coupling pacitor.

How accurate must meters for adio work be? Do they draw nuch power?

The first question, Tom, cannot answered by simply quot- some percentage, or a number watts, because the accuracy of ters and their power requirements y a great deal, depending on their plication.

The average mulitmeter found on y service bench is not likely to very accurate. But then, most dio components come in toler- ces of not less than 5 or 10 pc, and s is quite sufficient to cause that ch difference in meter readings, en in two identical pieces of ap- ratus. So a meter with this order accuracy would still be quite use-

Nevertheless, most workshops try maintain the accuracy of their truments well within 5 pc accur- y.

The amount of power required to e full scale deflection is almost finitesimally small. On the aver- e, meter movements have an in- nal resistance of 100 ohms, and quire 1 mA for full scale deflec- n. From this it follows that the wer required to deflect the meter a maximum of .1 mW. Many times s amount, however, is dissipated the multiplying resistance of volt- eters.

For special purposes, meters are so made to give full scale deflec- n with only 50 microamps, with internal resistance of about 2000 ms. The power required to operate ese works out at about .05 mW.

The next question also has some- ing to do with power, although not meters.

The rated power output of a 6V6 valve is 4.25 watts, at a plate voltage of 250 volts and a plate current of 45 mA. But the total input to the plate is 11.25 watts, acording to the formula. What happens to the excess 7 watts?

We could almost say, Tom, that goes up in smoke; or at least in at. In class A operation, usually t more than about 30 pc of the total ate input power is converted into eful energy or, in other words, such stage is very rarely more than 30 efficient.

It would be possible of course, to ive the valve harder, and so obtain gher power output. But as you ow, the harmonic distortion of a lve rises with increasing power tput, and there is a limit to the nount of distortion that can be erated.

Furthermore, the distortion per- ntage does not rise linearly. It s slowly at first and, after a cer- in output has been reached, starts rise very rapidly.

As "maximum power output" valve manufacturers usually specify a power level, at which the distortion is still tolerable, and usually not more than 5-10 pc. The remaining input power is dissipated in the form of heat on the plate and possibly the screen of the output valve.

The efficiency of power output valves depends a lot on their class of operation. The above figures are quoted for a single valve in Class A. Somewhat more than twice the power can be obtained by operating two valves in class B1, whereas in class B the efficiency rises to about 50 to 60 pc. In class C the efficiency may reach 70 pc, but the distortion is very high, so that this class of operation can only be used where total power output is more important than low distortion percentage.

Rear projection is the subject of the next question.

What kind of screen is used for rear projection of movies? Is it made of the same material as that for conventional front projection?

Certainly not, Tom. The image from the projector has always to be presented to the audience and conventional screens are opaque, with a highly reflective surface. If such a screen were placed between the audience and the projector (the arrangement for rear projection) the picture would be seen by the projectionist, but the audience would see little if nothing.

As light rays cannot penetrate opaque materials, the screen has to be transparent, or to be more exact, translucent.

Translucent screens such as ground glass — have the property of scattering sharply focused light rays, so that each part of the image becomes visible to the audience.

The ideal screen should scatter the incident light over 180 degrees, but most screens are very far away from this ideal. This is particularly so with ground glass and suchlike screens, which have a quite narrow dispersal angle.

Thus it can happen that the light striking the centre portion of the screen will be scattered within the viewing angle of the audience, but that striking the edges will not. The result is that the centre of the screen appears considerably lighter than the edges. The effect is called "hot spots."

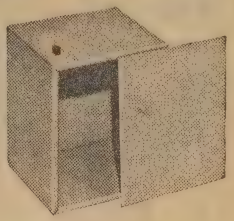
For this reason rear projection can only be used for a small audience with a small screen.

HERE'S YOUR CHANCE, TOM!

MR. E. HOUGH, of 1 Berring Ave., Lakemba, NSW, has several parcels of radio components and valves which he wishes to give away to schoolboy experimenters. They are in a near new condition. Mr. Hough is not on the telephone, but he is at home most evenings and weekends.

There is also a single speed turntable and pickup in a cabinet, for the first boy willing to take it.

METAL UTILITY CABINETS



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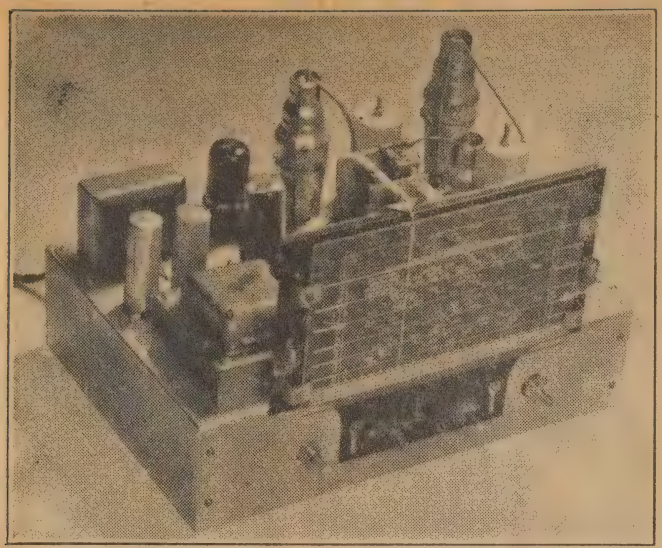


The completed D/W Basic Five receiver. The dimensions are sufficient to accommodate older valve types, as well as full-sized coils and IF transformers.

50 volts. These could be used by a
ing an extra screen resistor
bypass. A sectional circuit on p
53 shows the necessary addition
It would be possible to use s
of the duo-diode-pentode types
the audio stage, although a tri
is shown in the main circuit. Th
also require a screen resistor
bypass, and should be wired
according to the circuit on the sa
page.

NOT CRITICAL

Alternative output valves are a
possible, the main difference h
being in the socket connections
the bias required. Valves ot
than the 6V6 also require a 7
ohm plate load. This latter ite
however, is by far not as criti
as it is commonly believed, and
difference would be of little accou
So if you happen to have a 5
ohm output transformer, by
means use it. Alternative circu
for output valves also appear
page 53.
We will not again go into prec
details of the circuit, as it v
adequately covered in the Dece
ber issue, but there are a few poi
worthy of mention as regards mo
fications to the original circuit
allow the use of dual-wave c
units.

THE DUAL WAVE BASIC FIV

In our December 1955 issue we described the construction of a simple 5-valve receiver which could accommodate a wide variety of components. Retaining the original simplicity and versatility, we present this month an equivalent receiver with dual-wave coverage.

by **L. Varady**

ALTHOUGH the tendency today is away from D/W receivers without an RF stage, when well aligned and with high-gain coils, they can still put up a very creditable performance. The circuit therefore merits consideration by anyone having suitable components to hand or who may want to rebuild an existing set.

MORE COMPLICATED

The reason behind the declining popularity of this type of receiver lies mainly in the fact that the serious short-wave listener usually prefers a more complicated receiver which gives better reception even under difficult conditions.

But, for the occasional listener, who only tunes into the short-wave bands for a change of interest, such elaborations are not usually required, and for him the present set holds considerable attraction.

Besides, along with other components, prospective constructors may well have on hand a dual-wave coil kit, so popular some years ago and, if the additional coverage can be incorporated without extra cost, so much the better.

The only point to watch here is the dial scale. It should, of course, match the gang used, but it should also match the S/W coverage of the coil unit. There are two standard coverages: 16-50 and 13-42 metres, and it would be wise to check on this before installing a dial glass.

The circuit has been kept simple in order to allow a large variety of valves to be used. A five-valve superhet, it consists of a cofiverter, IF amplifier, audio amplifier and power output stage and a rectifier. The circuit diagram shows valves suitable for each of these stages.

Most of these alternative types can either be plugged straight in, or only require alteration of the socket connections. These types are listed on the main circuit diagram. Also listed are some other types which require alteration of circuit values.

Some converter valves—mainly Continental and Service types — require a screen voltage of only about

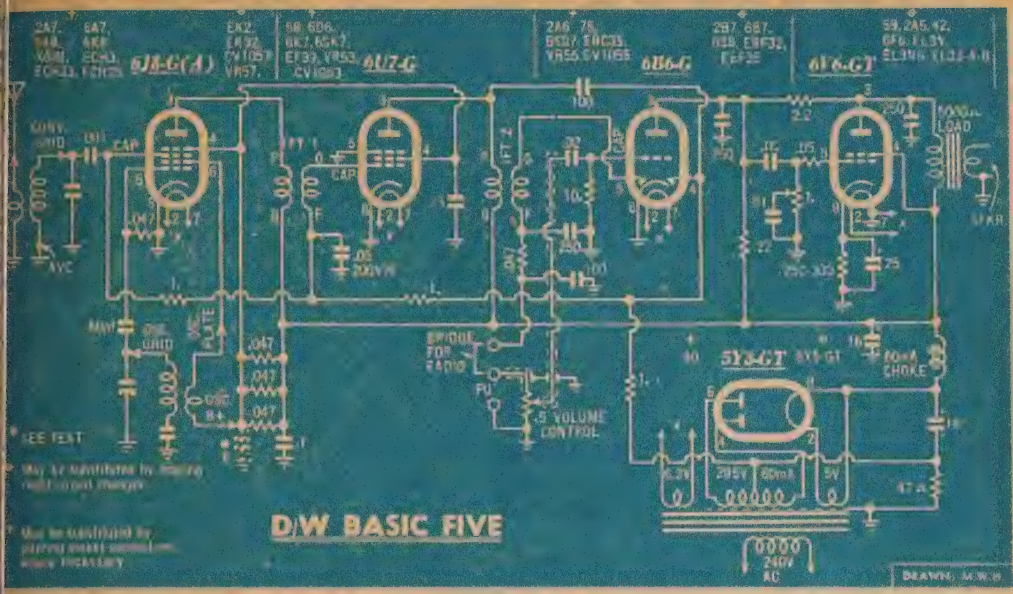
One of these concerns the A
circuit. In modern practice t
delay voltage for the AVC circ
is often derived from a back bi
resistor, the combined voltage bei
fed to the lower end of both t
IF transformer and the aerial c
secondaries through a suitable R
network.

This presents no problem whe
the coil terminals are accessible
the home constructor, as is the ca
when ordinary broadcast coils a
used. In a coil bracket, howeve
this is not usually the case. Diff
culties are likely to arise becaus
in many coil units, the SW aeri
coils are returned directly to ear
instead of to the AVC line.

SHORT LEADS

This is done to ensure short lea
to the coil and on the assumpti
that shortwave signals will not ove
load the early stage.
However, it does necessitate t
use of cathode bias for the convert
and IF valves, since no standi
bias can be applied on shortwav
via the AVC line.
Rather than recast—and compl
cate—the whole design, we modifi
the circuit to provide shunt AV
for the converter valve. This simp
means that the AVC voltage

CIRCUIT SUITS WIDE RANGE OF VALVE TYPES



The receiver employs a conventional superhet circuit with some features to allow the use of a wide variety of valves and coil units. Alternative types are shown. Note the arrows on the coil connections: these show where the coil unit is connected.

pplied to the converter grid rough a 1 meg resistor, and the gnal voltage from the aerial coil d through a .001 capacitor.

Thus both the S/W and the B/C erial secondaries can be earthed, nd the AVC will continue to oper-te, irrespective of the coil con-ected. With dual-wave coils units nerefore, the connection marked AVC" will now be earthed.

It would be possible, of course, o alter the coil unit, but this may e rather difficult and therefore est not attempted.

URTHER DECOUPLING

The other modification concerns he oscillator circuit. Apart from he .25 mfd RF bypass capacitor, hich is common to the converter nd IF screens and the oscillator -plus, no provision has been made or further decoupling of the supply. On the broadcast band this is not f much consequence.

It is a different matter on the hort-wave band where motorboating nay occur on a strong signal. If the ompleted set shows a tendency to notorboat on this band, the addition-l 8 mfd electrolytic decoupling apacitor shown dotted on the cir-uit diagram should be connected in he oscillator plate supply.

The remaining stages are perfectly traightforward and require no pecial comment. To eliminate any ossible instability effects, a .05 meg rid stopper and a 250 pf plate by-ass have been added to the output tage.

So far we have merely mentioned oil [illegible] in general and it may now e h[illegible]l to examine what kind of coil units are likely to be available to the home constructor.

A check through the manufacturers lists show that at some or other time most of them have brought out such a unit, in some cases several units. Almost any one of these would be suitable, provided they use iron-cored coils for the broadcast band.

Coil kits having air-cored broadcast coils are not so suitable, as they are likely to be early types and possibly very inefficient by present standards.

The electrical properties of the more modern units follow the same general pattern, so that any one of them should give good service in this receiver.

Also, whilst the connections may be coded differently, they require the same connections to the set: Aerial (Converter) Grid, AVC, Oscillator B plus, Oscillator Plate and Oscillator Grid. The chassis or mounting plate of the units provide the earth connection in some cases, in others additional bonding is provided for.

Connecting arrangements are different on each unit; on one the connections may be brought out to a terminal strip, on the other they may have to be made to the switch con-

PARTS LIST

1 Chassis 13in x 9in x 3in (Simplified B/C Receiver July 1950).
1 Power transformer 285 volt 60 or 80 ma. 6.3V 2A. 5V. 2A.
1 60 or 80 ma 30H choke.
1 Dial D/W glass suit gang (USL32 or similar).
1 Speaker, permag type, size as required. Transformer to suit output valve.
1 D/W coil unit (Aerial and Oscillator).
2 455 Kc IF transformer Nos. 1 & 2.

VALVES

1 6J8G, 1 6U7G, 1 6B6G, 1 6V6GT 1 5Y3GT, or alternative types. See text.

RESISTORS

1 10 meg. ½W, 1 2.2 meg. 1W 1 1 meg. pot 3 1 meg. ½W, 1 .5 meg pot., 1 .22 meg 1W, 3 .047 meg. 1W, 3 .047 meg. ½ W 1 250 or 300 ohm 1 or 3W (See text)., 1 47 ohm 1W.

CAPACITORS

1 25 mfd 40V electrolytic, 2 16 mfd 350V electrolytics (one insulated type). 1 .25 mfd 400V paper, 1 .1 mfd 400V paper, 1 .05 mfd 400V paper, 1 .05 mfd 200V paper, 1 .02 mfd 400V paper, 1 .01 mfd 200V paper, 1.001 mfd mica 1 425 pf mica, 1 2 gang tuning capacitor, 3 250 pf mica, 1 100 pf mica, 1 50 pf mica 2 trimmers.

SUNDRIES

5 Octal sockets or as required for valves, 3 valve shields or as required. 1 4 pin socket, (standard size). 1 4 pin plug to match, 2 red terminals 2 black terminals, 1 green terminal, 3 grid clips, 1 5 tag terminal strip, 2 3 tag terminal strips 3 knobs, 1 8 tag terminal strip, shielded hookup wire, plain hookup wire, solder lugs, nuts and bolts.

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ts directly, or to separate flying ds.

Whatever the arrangements are, the t should be mounted in a position ich will allow the shortest pos- le connecting leads to the signal d, the oscillator grid and plate. In s way, interaction between the ds is kept to a minimum and cking is not prejudiced.

This of course means that no uni- sal directions for mounting the cket can be given, which will t every possible unit. Accordingly examined our stock of coil units get an idea about the possible unting arrangements.

MPLE LAYOUT

Our receiver was built on a chassis x 9 x 3in, as specified originally the Simplified Broadcast Re- ver. The layout is quite simple, various components and valves ng grouped around the tuning g, which takes up the centre of the ssis.

Viewing the set from the front, left hand side is occupied by the mponents of the power supply.

On the right hand side we have converter valve next to the gang, two IF transformers and the IF ve on the corner of the chassis, then along the rear the audio plifier and the power output ves. The rectifier is in line with output valve, slightly toward the tre.

Underneath the converter valve, at front of the chassis is the space erved for the coil unit.

The additional control, the wave nge switch, necessitated the re- angement of the controls on the nt panel. From right to left we e the wave-change switch, volume trol, tuning spindle and tone con- l. The two centre controls are unted on the dial plate proper in holes provided.

The exact position of these two trols is not very critical and they uld be interchanged, should the e of the coil unit dictate some nge.

Also, if using a ready-made chassis, holes for the two outside con- ls may have to be slotted to make spacing of the controls even.

NGLE HOLE MOUNTING

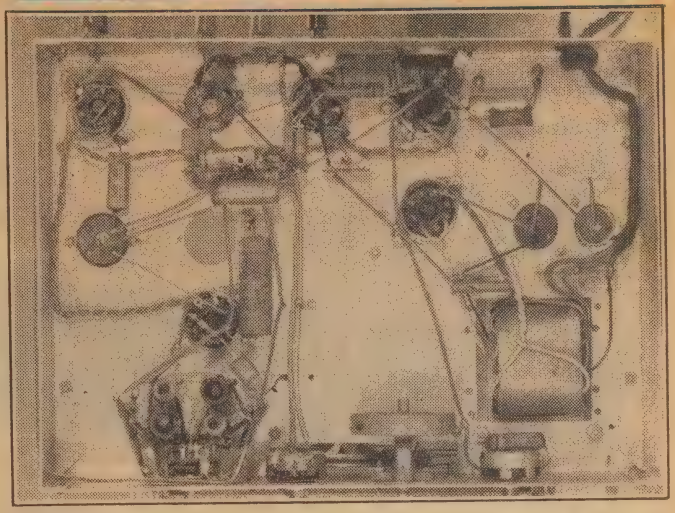
Some of the units such as those de by RCS, Bramco and Q-plus, of the single hole mounting type, have connecting lugs extending enough to enable them to be unted directly on the front of the ssis.

Others, such as the Aegis and ngsley types, are of the stud unting type, and may need to be ced back from the chassis face pillars, or on a small bracket of table size.

Incidentally, the unit we have wn in the photographs is one de by Q-Plus.

The connections on some of the brackets are such that in some es it is possible to mount them h trimmers and core adjustments truding from the underside of chassis. On others, however, rt connecting leads can only be ieved, if the unit is mounted with adjusting screws toward the top the chassis.

UNDERNEATH VIEW OF WIRING



Underneath view of the receiver, giving a clear picture of the wiring. There is plenty of room around the converter socket to accommodate most of the popular makes of coil brackets.

In the latter case a cutout of suitable shape will have to be made on top to provide access to the adjustments.

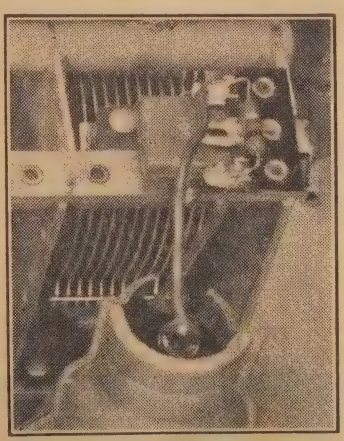
If you are using a ready-made chassis, there will be a hole provided for the B/C oscillator coil. In most cases it would be sufficient to extend this hole toward the edge. This can be done with a chassis punch, or the outline of the cut-out could be marked on the chassis, and small holes drilled around the marking. The excess metal can then be removed with a pair of pliers and the edges cleaned up with a file.

With all the major components in position the wiring can be proceeded with. Most of it is point to point, only a few decoupling and bypass components being mounted on a tagstrip near the second IF transformer.

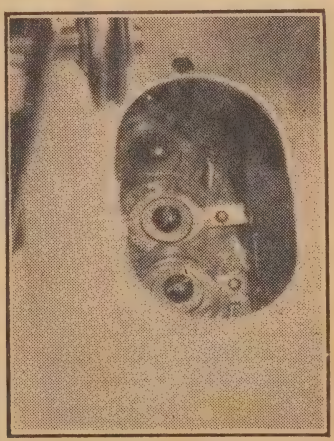
The orientation of the valve sockets will depend on the actual valves used. The important point is to keep all grid and plate leads carrying RF as short and direct as possible.

As pointed out earlier, the oscillator leads should be short, and to this end the gang section nearest the dial should be used for the oscillator section.

A long converter grid lead can also be avoided by connecting the lead from the coil unit to the bottom terminal of the gang, and supporting the coupling capacitor and



Close-up photograph of gang shows mounting of AVC resistor and coupling capacitor.



Another close-up showing the access hole to the trimmer and core adjustments.

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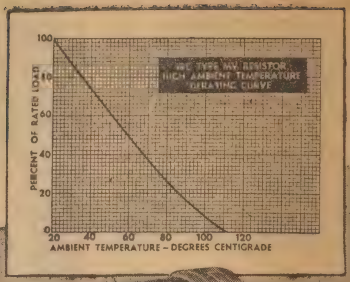

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					Ceramic Length	Resistor Body Diameter
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MVG	4 watts	5,000	10,000 ohms	700 megohms	2"	9/16"
MVJ	5 watts	10,000	20,000 ohms	1,500 megohms	3"	9/16"
MVP	10 watts	15,000	50,000 ohms	2,000 megohms	4-1/2"	3/4"
MVA	20 watts	25,000	0.2 megohm	4,000 megohms	6-1/2"	1-1/8"
MVO	30 watts	50,000	0.4 megohm	8,000 megohms	10-1/2"	1-1/8"
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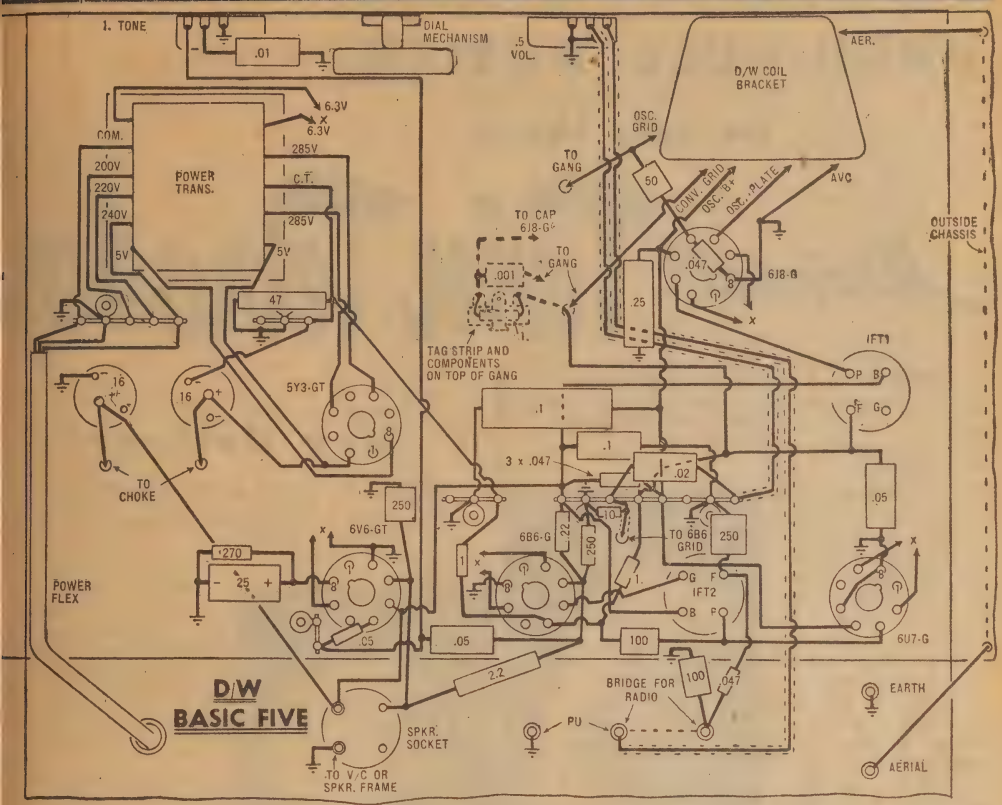
WIRING DIAGRAM SHOULD HELP THE BEGINNER



We have prepared a wiring diagram for those of our readers who are not so familiar with circuit diagrams. The resistor and capacitor, shown dotted, mount on top of the gang.

id resistor on a small tagstrip soldered to the top of the gang frame. ie AVC lead is "cold" for RF d it does not matter, if it is nger than usual.

The converter plate lead should taken to the IF transformer as rectly as possible. The other two ads, B-plus and AVC, can be ken to it by any convenient route, hereas the grid connection to the valve will require a little thought. he AVC bypass capacitor should connected to pin F or the IF transrmer.

OP GRID CONNECTION

With the exception of the 6SK7, ie valves listed as suitable for ie IF stage, have their grid conections on the top cap. In the first ase, the grid connection is simply ade by connecting the lead beveen the grid pin of the IF transrmer and the appropriate pin on ie valve socket.

The remaining valves, however, ill require a lead from the top of ie coil can to the top cap. Older pes of IF transformers already have is top lead, but more modern ones ave not, as they are not required r the new single-ended valves.

It does only take a short while, however, to install such a lead in the 1st IF transformer. Undo the crimped edge at the base of the transformer and slip the coil carefully out of the can. Drill a small hole into the top of the shield can, slip a length of hook-up wire through the hole, and solder the end to the G-pin of the transformer inside the can.

The transformer can then be reassembled and the edge of the can again crimped over the base. After cutting the lead to a suitable length, a grid clip is soldered to it and the transformer is ready to be used with the older type valves. The size of the grid-clip will depend on the valve used, and should be checked before installing.

TAG-STRIP MOUNTING

The oscillator decoupling resistors (3.047 meg 1W), as well as the diode load resistor, the B-plus RF bypass and the audio coupling capacitor, are mounted on a 7-lug strip near the 2nd IF transformer. To avoid possible instability, the body of the AVC diode load resistor should be placed as close to the socket pin as possible.

It will also help to keep the 100 pf mica capacitor between IF plate and AVC diode close to the chassis, and out of the way of the audio wiring.

Another important precaution is to mount the .05 meg grid stopper of the output valve right next to the grid pin of this valve. A small tag strip fixed under one of the socket mounting bolts will help at this point.

MAY BE UNSHIELDED

This tag strip will also serve as anchor point of the tone control lead, which may be unshielded. The gain at this point is so low that no trouble from hum is likely to occur.

If perchance hum is experienced with some of the high gain types of output valves, a length of shielded lead could be installed in this position.

The value of the plate bypass capacitor is given in the circuit as 250 pf. Some sets may require less than this, and this can be determined by experiment. No more than this should be necessary, however.

Although not shown on the circuit, one side of the voice coil circuit should be earthed and, if possible, also the loudspeaker frame. Any stray RF radiation from the leads will then be avoided.

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PVI8-55

As the circuit stands, it is suitble for the connection of any permanent magnet dynamic loudspeaker. Naturally one would not use 3in speaker with this type of reiver. Even a 5in speaker would e on the small side, but anything rger would be suitable. The output ansformer should be mounted on ie speaker frame.

If one is on hand, an electroynamic speaker could also be used ith one modification to the circuit. s these loudspeakers require about 0 volts, for energising the field il, it would be necessary to use power transformer with a 385 V ide secondary. The speaker field connected in place of the choke, ie usual resistance values being om 1500 to 2500 ohms.

As the choke is omitted, when ing an electrodynamic speaker, e output transformer could be ounted on the chassis in its place, ould this be necessary.

NCREASED RATING

However, if an electrodynamic eaker is used, the rating of the ro filter capacitors should be ineased to 600 volts.

If a check through the wiring does ot reveal any obvious mistakes, e set can be plugged in and sted. It would be wise to switch e set on without the rectifier first, st in case. Should the rectifier ow signs of flashing internally, or ould its plates begin to show color hen the rectifier is installed, it n be taken as an indication of short in the B-plus circuit. If erything appears to be all right, e alignment can be commenced.

The first step would be to adjust e dial pointer for equal overlap both ends of the dial. This will oid difficulties later, when align- the oscillator circuit.

If a signal generator is at hand, e IF transformers should then be aked on 455 KC. With new IF ansformers, only about half a turn the cores should be sufficient bring them into line, as they are justed before they leave the facy.

Then the oscillator core and trimer should be adjusted, until the ations line up correctly with the arkings on the dial, and finally e aerial core and trimmer adjusted r correct tracking on the low d high frequency end of the dial spectively.

AME ON BOTH BANDS

The same procedure applies to e S/W band, except for the IF ansformers, which need not be uched, as the intermediate freency is the same on both the W and the B/C bands.

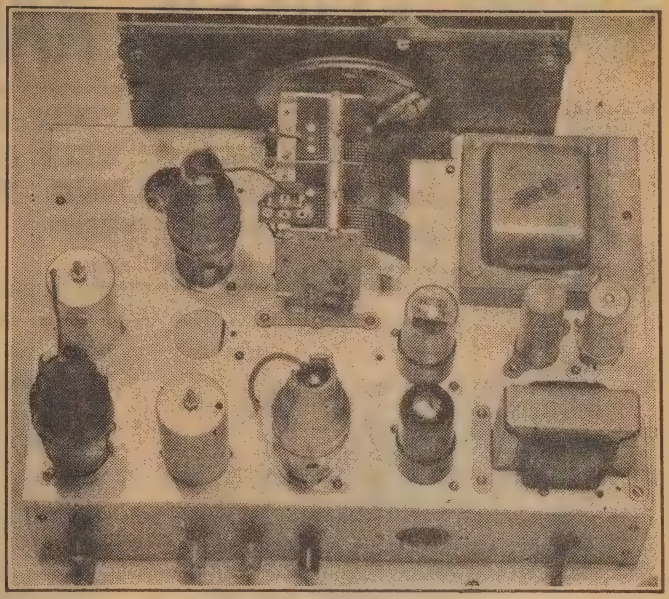
A slightly different procedure apes, if the set is to be aligned thout the aid of a signal generaIn such a case, the oscillator re and trimmer are adjusted, til the stations appear in their rrect places on the dial. Then llow the aerial circuit adjustments d finally the IF transformers.

When aligning "by ear" a weak ation should be used preferably, the aerial disconnected from the ceiver, otherwise the AVC will sk the effect of the adjustments.

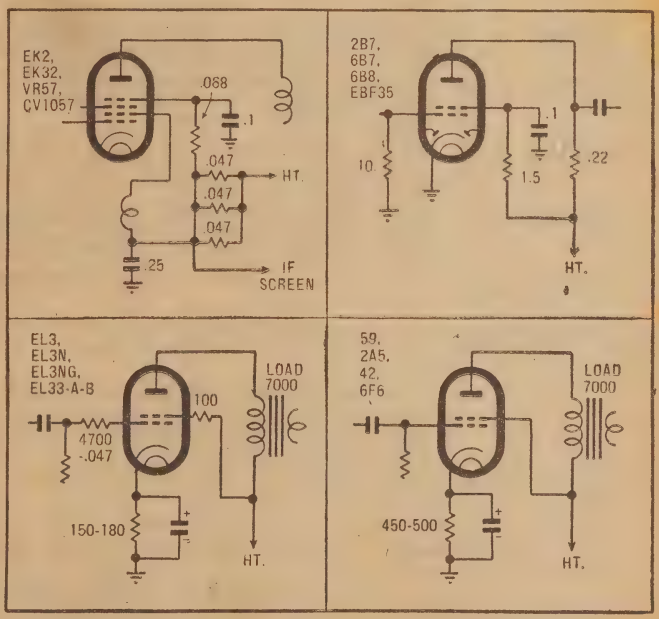
On the S/W range the adjustment the oscillator circuit should be postponed until some of the stations and their frequencies have been identified. Only the aerial core and trimmer should be aligned at this stage.

More complete alignment instructions are available in the form of a booklet, which can be supplied through our two shillings aery service.

A REAR VIEW OF THE CHASSIS



Rear view of the receiver showing layout of major components. The output transformer could take the place of the choke, if an electrodynamic speaker is used.



Some of the suggested alternative valves need minor circuit alterations. Auxiliary circuits for the converter, audio amplifier and power output stages are shown here.

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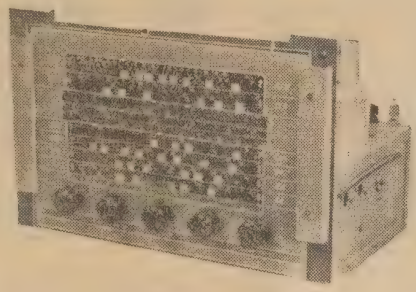

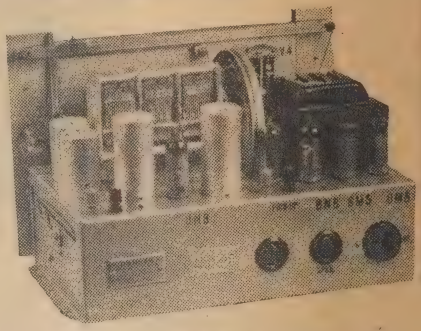

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FROM THE SERVICEMAN WHO TELLS

For a really nasty fault I think this month's story of faulty valves will be hard to beat. I'm sure no textbook ever described anything like it And, then, a reader's letter has caused me to launch forth on the old story of by-passes on the HT line, while another reader describes yet another way to "butcher" a speaker.

MY experience with the faulty IF valves was one of the most puzzling — and, at the same time, interesting — that I have had for some time. It started with a very ordinary five-valve mantel set which had suddenly become hopelessly unstable. Such sets don't normally worry me unduly; it's the beginner's effort which is that way from the start which really gets me down.

Normal sets which suddenly develop such tendencies usually suffer from something relatively simple, such as an open circuited screen bypass or lack of by-pass on the HT line (more of this a little later).

NOT SO EASY

But this one responded to none of the usual treatments and I spent a lot of time checking less obvious possibilities, on the assumption that it could be one of those rare cases where someone had fiddled with the set (although it did not appear so) or it had always had a defect which had not shown up until now.

Just when I was about at the end of my tether I happened to place my hand round the IF valve (a 6BA6) whereupon the violence of the oscillation was reduced, though the trouble was by no means cured. A temporary metal shield had a similar effect.

It took only a moment to slip another valve into the socket and — hey presto — the trouble vanished. Clearly a case of a faulty valve and, beyond making a few uncomplimentary remarks about said valve, I was prepared to let it go at that. If I thought about it at all, it was probably to the effect that the internal shield had become disconnected from its base pin.

SECOND CASE

It was not long after this that I struck an identical case which, in the light of previous experience, I was able to dispatch quite rapidly. I was beginning to wonder about the coincidence when I happened to mention my experience to a colleague, only to discover that he had experienced a couple of similar cases. One had been the 6BA6, the other a 6N8.

To cap it all I struck my third case not long after, this time another 6N8. I decided it was time to make some more enquiries. After all, this number of cases in a short while over a small area could hardly be coincidence. Others must have experienced the same fault.

I began to question various colleagues whenever the opportunity occurred and discovered that several had encountered at least one case. I also made some discreet enquiries as to the real cause of the trouble. Was it really an open circuit shield or was there some other cause?

Bit by bit I was able to piece together a logical story. Briefly there appear to be two possibilities. One is the failure of the shield connection, as I had already suspected, and the other is a rather more subtle effect involving increased grid-plate capacitance.

The open shield appears to be due simply to failure of the particular welded joint, though why this joint should be more prone to failure than any other I am unable to say. However, this does appear to have been the case in certain batches.

The other trouble is not so easy to explain, particularly as I make no claim to being a valve engineer. However, it appears that the grid-plate capacitance can increase during the life of the valve to many times its nominal value, unless certain precautions are taken during manufacture.

METALLIC DEPOSIT

It is due to the formation of a metallic deposit on the support micas, this coming from the heated nickel sleeve on which the cathode material is sprayed. To prevent this the micas are normally sprayed with a material which either inhibits the deposit or breaks it up in such a way as to prevent it forming a continuous film.

Occasionally, as in this case, the mica spray fails to do its job properly, either in an isolated case or for a whole batch. The result is a valve, or batch of valves, in which the grid-plate capacitance can gradually increase as the valve ages, eventually reaching the point where the stage involved becomes hopelessly unstable.

It seems that this condition is aggravated considerably by even slight over-running of the filament, and high line voltages could therefore hasten the effect. In fact this is used during production to speed up the effect and permit sample checks to be made.

So there it is, all very nice when explained in cold blood, but in my opinion "a fair cow of a trick" to play on any serviceman!

READER'S STORY

And now for a reader's comment. From Mr. B.A.W., of Nowra, NSW, comes a story of an old autodyne set and a very common fault—even in some modern sets. He tells the story as follows:

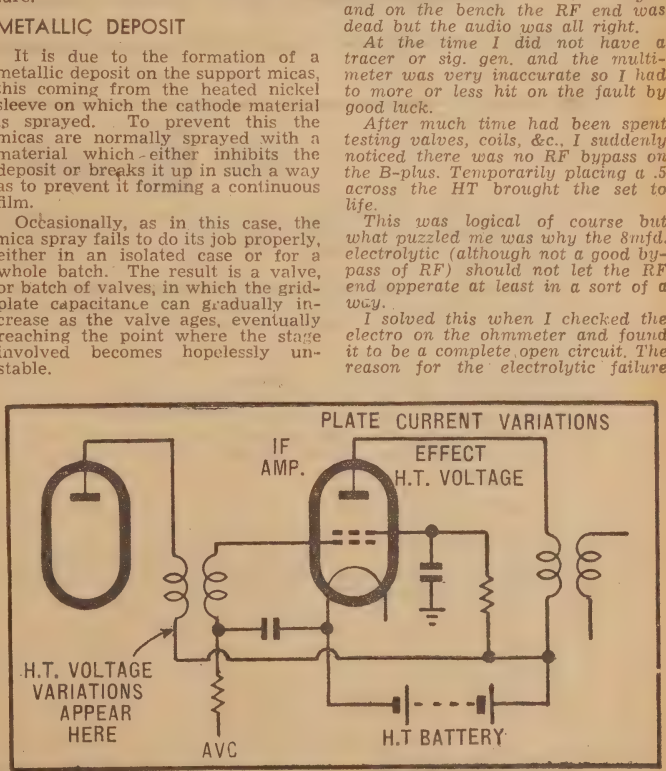
My "serviceman" act was to "fix" (a magic word) an old receiver belonging to a friend. The set in question was a rather ancient autodyne and on the bench the RF end was dead but the audio was all right.

At the time I did not have a tracer or sig. gen. and the multimeter was very inaccurate so I had to more or less hit on the fault by good luck.

After much time had been spent testing valves, coils, &c., I suddenly noticed there was no RF bypass on the B-plus. Temporarily placing a .5 across the HT brought the set to life.

This was logical of course but what puzzled me was why the 8mfd. electrolytic (although not a good by-pass of RF) should not let the RF end opperate at least in a sort of a way.

I solved this when I checked the electro on the ohmmeter and found it to be a complete open circuit. The reason for the electrolytic failure



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THE BJ ARM

Technical Report by P. WILSON, M.A:, *quoted from* THE GRAMOPHONE:

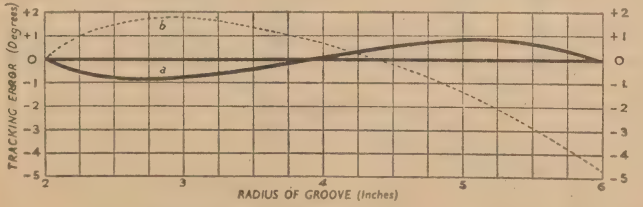
It is beautifully made, and indeed is an example of precision workmanship. Notwithstanding the four extra pivots, the lateral motion is without play and as sleek as velvet.

In addition, stylus wear will be reduced and becomes more of the nature of a polish, not only by the better seating of the stylus in the groove but also because it will now track with reduced pressure. This in its turn will decrease record wear.

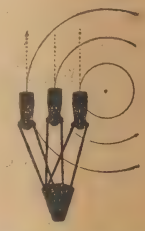
These virtues are not mere theoretical deductions. They are readily observable in test conditions. In particular, the crispness of the response, especially in the bass, and the increased articulation and resolution of different instruments in orchestral records are easily discernible. . . .

It will be gathered from all this that I am enthusiastic about this BJ Arm. I am indeed. It is certainly the most satisfactory swinging arm that I have ever seen.

Below: TRACKING ERROR CURVE. (a) The BJ arm. (b) Conventional bent arm.



INCORRECT TRACKING with Conventional Arm.



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ıay have been that it was wired cross the voltage divider and the eat dried the electrolyte. (The con- enser was a new looking one re- placing the old can types.)

Another interesting point is that he hum level had not risen with he failure of the electro and the et operated quite well with only 8mfd electro and the field coil n the filter network.

The set had just come back from he local serviceman as "not worthy f repair" and as its performance vas almost equal to that of a nodern 5 valve superhet I was uite proud.

Yours faithfully,
B.A.W.

SIMILAR CASE

I have quoted Mr. B.A.W.'s let- er for two reasons. Firstly, the ncident is similar in several re- pects to my own first encounter ith the need for adequate HT y-passing, and, secondly, it gives ıe an excuse to discuss this need t some length.

My case also involved an auto- yne (in the days when they were great deal more popular than ıey are now) and it had also been given away" by the local service- ıan. Similarly again, yours truly ad only a multimeter, very little xperience, and a lot of confidence. Much more than was justified, as turned out!)

Only in one respect did my case iffer. The set was not complete- dead—only woefully weak, and is in a district not renowned for gh field strength.

When I received the set I learned ıat the previous serviceman had hecked all the valves and re- laced two which appeared to be ck. The others he pronounced OK nd addded that he could find noth- ng else wrong with the set. Ac- ording to the owner it was little etter than before the new valves ere fitted.

OME HELP

I was glad that the valves had een tested because it eliminated ıe possible source of trouble; one hich my limited facilities at that me would have had difficulty in pping with.

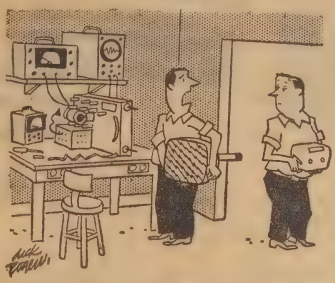
So I set the chassis up on the ench and went to work. The first ing I noticed was a faint but uite definite hum in the speaker. ven in those days I was inclined regard any hum as too much nd made a mental note that this as something which would have be fixed—after I had cured the ain complaint. Had I but realised I was pushing aside a valuable ue—in fact, THE clue—to the hole problem.

But I didn't realise it, and set work to check everything I uld with my limited gear. I ecked voltages, currents, resist- nces, the gain of the audio stage n the time honored manner), the ignment (by ear) and everything se I could think of. Everything emed OK.

I went over everything again with ıe same result. At the end of a uple of hours I was no nearer e solution and was forced to the alisation that here was something at looked like beating me; some- ing I just couldn't understand; mething which didn't seem to be cording to the textbooks.

I was baffled—and worried. I had only taken the job as a spare time project, and the possibility of a financial loss did not worry me. But to have to admit defeat; to be forced to return the set and say; "I'm sorry, I can't fix it either"; that was unthinkable. Yet I had to admit that, for the moment at least, I was beaten.

I decided to "sleep on it" and tackle it fresh in the morning. One good feature was that the owner had been able to borrow a spare set and I could keep this one for as long as I needed.



"Darn it! Nothing seems to clear up the trouble" (Radio-electronics)

The morning brought a few fresh ideas, but nothing that proved to be of any help. After a couple more hours on the thing I realised I was simply going round in circles —checking things which I had already checked three or four times —and getting nowhere.

With minor variations this went on for three or four days. I fiddled and probed, consulted every textbook I could lay my hands on, even appealed to some other enthusiasts for help. All to no avail. I was licked.

The final realisation of this left me with a feeling of utter helplessness, and I suppose it was this that prompted me to do what I did next. I had given away all idea of finding the trouble, but, subconsciously, I suppose, I needed something to bolster my ego. I decided that if I couldn't fix anything else, at least I would fix the hum.

THE CURE

Suspecting the second electrolytic, I seized a spare and bridged it across. The next moment I was on top of the world. Not only had the hum vanished, but the set had suddenly "come alive" in no uncertain manner.

No longer was there any doubt about its performance; a half turn of the volume control brought forth a burst of noise that sounded sweeter than any music; tuning across the band revealed all the usual stations. The problem was solved; my reputation was saved. I felt really jubilant.

When I had calmed down a little I naturally wanted to know why things had happened thus. So far as I knew up till that time the only purpose of an electrolytic was to serve as a storage reservoir to filter the pulses of energy from the rectifier. How did it happen that its failure could affect the front end of a set?

In point of fact the second electrolytic has another job to do, and one that is quite frequently overlooked. It must provide a low impedance path for all the signals which normally appear in the plate circuits of the various valves, because all such signal currents must flow through the power supply.

Another way of looking at it is to say that the power supply must maintain (ideally) a constant voltage to the HT line during the many short term variations in current drain which represent the signal currents in the valve plate circuits. Although perfect regulation is not normally possible, it needs to be of a fairly high order.

In order to understand why this is necessary, let us consider the basic circuit of an IF amplifier stage. This is shown in the accompanying sketch and, for simplicity, a battery is shown as the source of plate power.

STATIC CONDITION

Assume for the moment that no signal is applied to the grid and that there is a steady plate current whose value is determined by the plate voltage and grid bias. This is known as the static condition.

Now assume that a signal is applied to the grid, being in the form of an alternating voltage, and that the first cycle is positive going. This means that the effective negative bias will be reduced and the tendency will be for the plate current to rise.

But suppose when we try to increase the plate current the voltage of the battery falls, due to the battery's own internal resistance. This will limit the rise in plate current, making it much less than if the plate voltage remained constant.

On the negative half cycle the reverse action will occur. The natural tendency will be for the plate current to fall, but rising battery voltage will again limit the order of change.

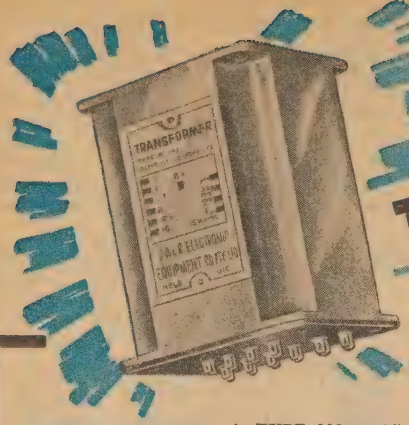
Thus the amount of plate current change in the load will be less than it should be and the gain of the stage substantially reduced.

Another way of looking at it is that the resistance of the power supply becomes comparable with the impedance of the valve's plate load. Since the signal current must flow through the power supply, any resistance in this part of the circuit will allow signal voltages to be developed across it. Such voltages are wasted, because they should be applied to the load whence they can be passed on to the following stage.

EVEN WORSE

In fact they are worse than wasted, they are allowed to appear in parts of the circuit where they have no business and where they can cause a lot of trouble. So far we have only considered a single stage, but imagine what happens when an earlier stage, say the converter, is connected to the same power supply. Any voltage variations caused by current changes in the IF stage will also appear in the plate circuit of the converter.

These changes (or signals) are amplified versions of signals which originated in this same plate circuit and have only to be in correct phase and of sufficient amplitude to cause hopeless instability. Whether the phase is correct or not depends mainly on the phasing of whatever coupling transformers are involved,



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Sec.: 500, 250, 166, 125 and 100 ohms.

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TYPE 931-8: 20 watts.
Prim.: as 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15.
Valves: As 931-15.
19% Screen Taps.

TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7, or 15 ohms.
Resp.: 10-60,000 cps.
Valves: 807, KT66, etc.
19% Screen Taps.

TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
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TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.:10-50,000 cps.
Valves: 6BW6, 6V6., KT61, etc.
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TYPE 916-8: 12 watts.
Prim.: As 916-15. Sec.: 2 or 8 ohms. Resp.: As 916-15.
Valves: As 916-15.
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TYPE 949: 12 watts.
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) it is more or less a chance effect. However, the whole thing can be uch more complicated than that. nwanted signals across the power ipply can appear in every stage of .e set, even across the output stage id into the speaker wiring. From re they can couple back into earlier ages by reason of capacitive coup- ng and loudspeaker leads.

ANDOM EFFECTS

In some cases they may couple to ie stage in such a manner as to use degeneration, and to another cause regeneration. It's simply a atter of luck which wins out, and plains why some sets appear ore sensitive to the absence of a pass than others.

It also explains why battery sets ith partly run down batteries will ten become unstable and useless, en though the voltage of the bat- ry is still high enough to drive the t. Which is why, in all properly signed battery sets, you will find th an electrolytic and paper by- ss effectively across the HT ttery.

By acquiring a charge equal to ie battery voltage under static con- itions these capacitors hold the HT oltage very nearly constant as the rrent varies; feeding energy into ie HT system when the current ses and taking it away (to charge emselves) when the current falls id the voltage tends to rise.

Quite naturally the frequency at hich the current drain varies will termine the value of capacitance quired to maintain an essentially nstant voltage over one half cycle. t radio and intermediate frequencies the time occupied by one half-cycle is quite small and only a small amount of capacitance is required to hold the voltage constant for this period.

At low audio frequencies the time involved is quite large and a lot of capacitance is needed, hence the use of the electrolytic. At first glance it would appear that this should be sufficient, since the amount of capacitance would be more than adequate for the higher frequencies. Unfortunately, electrolytics are very poor performers at high frequencies, so it is necessary to provide a paper type having sufficient capacitance for radio and intermediate frequencies.

The main cause of the electrolytic's poor showing at RF is due to a fairly high resistance effect, which is a natural part of such devices. This appears as a virtual resistor in series with the true capacitance and effectively limits the the rate at which this can charge and discharge. At low frequencies this effect is of little consequence, but it becomes significant as the frequency rises.

AC THE SAME

Although we have been assuming a battery as a source of power, exactly the same reasoning applies to an AC power pack. The last electrolytic must store enough energy to hold the voltage constant for a period equal to one half cycle at the lowest frequency to be handled. Further, because of the electrolytic's limitations, the HT supply should also have a paper by-pass to handle the higher frequencies.

It is perhaps unfortunate that the average electrolyytic is generally good enough when brand new to function at radio frequencies. This allows "pinch-penny" manufacturers to omit the paper by-pass—at the saving of a few pence—and to "get away with it", at least long enough to be discharged of their responsibility for the set's behavior.

Summing up, then, we may say that a major requirement in any valve amplifier supply is a power supply having essentially constant voltage characteristics or, putting it in more usual terms, having a low internal resistance. Batteries have this normally when new, but may fail early in their life. They must have the necessary capacitors across them if the full life of the battery is to be obtained.

LAST ELECTROLYTIC

In AC supplies it is the job of the last electrolytic to provide this low resistance. It is capable of doing this when new, but soon fails at the higher frequencies while still good at the lower ones. It needs a paper by-pass to avoid the risk of abnormal operation when this occurs.

So now we know—I hope!

Dealing more specifically with BAW's case there is one further possibility to consider. The autodyne has always been known as a cranky oscillator when things were not "just so", and a high impedance return path was one of the best known methods of putting them out of action. The result, naturally, was a completely dead set.

I have no means of knowing whether this was so in this case but an electrolytic as bad as this one apparently was could stop the set from operating.

My second letter comes from a schoolboy, E.M., of Albury, NSW, and describes yet another method of butchering loud speakers. I will let him tell it in his own words:

"I have a story of a butchered speaker and a little mass (electronic) murder.

"A boy I know at school decided to fit an extension speaker to his mother's set. Instead of connecting it to the secondary of the speaker transformer he connected one side of the voice coil to the B-plus side of the speaker transformer primary and the other side to the chassis.

"At this point his mother called him so, switching on the set, he went to see what she wanted. A moment later his sister ran out to tell him that the set was 'on fire'.

"The power transformer was fried, the rectifier (80) was blown, and his 'extension' speaker burnt out.

"At school next day he enquired of a friend and myself what caused the damage!"

Well thanks E.M. and I think we can agree your story rates with others we have had in this series. Regarding the incident itself I feel that most comment would be superfluous. I can only quote the old adage: "A little knowledge is a dangerous thing."

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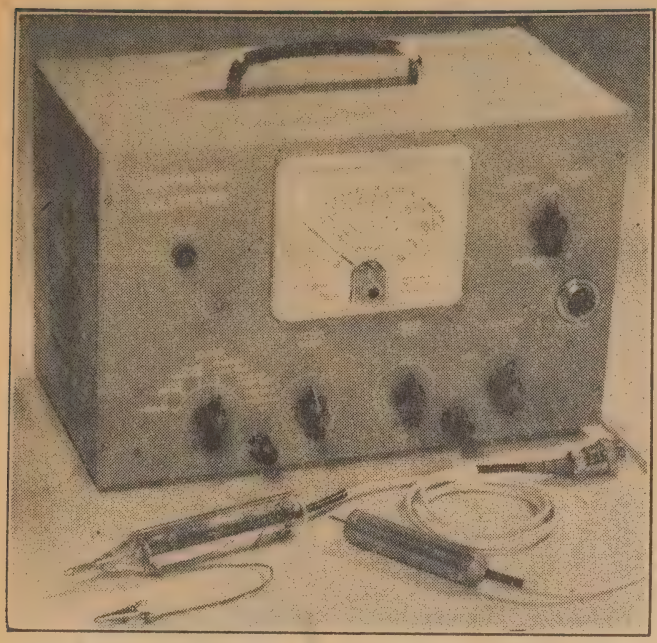

Two external probes complete the vacuum tube voltmeter project. Little constructional effort is involved but the theory of their behavior is not as simple as may first appear.

PROBES FOR THE VT VOLTMETER

To complete the discussion on the vacuum tube voltmeter described last month we deal here with the theory of the diode rectifier and show how the usefulness of the instrument can be extended by means of auxiliary probes.

by Maurice Findlay

IT will be appreciated that the basic instrument is designed primarily to provide a high resistance input permitting measurements on high resistance DC circuits and high impedance AC circuits at frequencies within the audio and low RF ranges.

For the sake of convenience, only two terminals are employed and the high order of stability resulting from the balanced circuit enables the instrument to be used much after the manner of a conventional multimeter.

INPUT LOADING

However, with the diode rectifier inside the instrument and the normal switching circuits, there are inevitable stray capacitances, such that the loading becomes excessive at higher radio frequencies. Considerable improvements in this respect can be made by employing a special probe construction as detailed later in this article.

You will recall that the basic circuit of a shunt diode VTVM is that shown in figure 1. Any DC component in the signal being measured is eliminated by the presence of the capacitor C.

As the alternating component of the applied signal swings positive on the initial quarter cycle, the diode presents a low impedance and the signal source is heavily loaded. The energy drawn from the signal source causes capacitor C to be charged, the rectifier terminal of the capacitor (point X) becoming negative with respect to the input terminal.

During the second quarter-cycle and the following negative half-cycle the diode does not conduct and the charge on capacitor C remains.

It is fairly clear then, that after the initial positive quarter-cycle, the potential of X follows the waveshape of the input signal with the charge on capacitor C superimposed.

When the signal reaches its negative peak, therefore, point X is negative with respect to earth by twice the peak input voltage. On the other hand when the signal reaches its positive peak, point X just rises to earth potential.

So far, we have assumed that the heavy loading during the initial charge does not cause the signal voltage to drop but in most cases this is not true and the steady charge on C will not build up to its full value until a number of cycles have been completed.

Also we have assumed that the value of R is so high that the charge leaking away through it can be neglected. This is not perfectly true and in actual fact point X does become slightly positive with respect to the diode cathode (earth) and the valve does conduct for a small part of the cycle.

Looking at the behavior of the circuit in a slightly different way, the energy drawn from the input source during these brief conduction periods must make up for the energy dissipated in resistor R during the remainder of the cycle when the diode is non-conducting.

All factors considered, we have at point X an alternating current wave upon which is superimposed a DC component, the latter negative with respect to earth. Before the DC amplifier is connected it is usually desirable to connect a filter which will eliminate the AC but leave the average value of the DC component.

The waveshape at point X is shown in figure 2 which can be studied in conjunction with the previous few paragraphs.

PULSE READINGS

The time constant of the circuit (RC of figure 1) must be long enough to preserve the charge in C over many cycles but not so long as to prevent the instrument registering variations in the peak value of the signal slow enough to be observed visually.

This aspect of the behavior of the instrument is illustrated when a series of pulses is applied. Unless the duration of the pulses is very small or the space between the pulses large the VTVM will read the peak value.

Two points, essential to the intelligent use of a shunt diode, VTVM, should be gained from the foregoing discussion.

The input resistance is not constant throughout the cycle but rather its dynamic value becomes low during the small part of the cycle that the diode conducts.

Depending on the internal impedance of the circuit being measured and the losses in the diode voltmeter circuit, this can result in appreciable distortion of the signal.

CALIBRATION CONVENTION

The second point is that the reading of the VTVM is proportional to the peak value of the applied signal. The usual convention is to calibrate such instruments is RMS values when the applied voltage has sine wave form.

It would be quite easy to calibrate the scale in peak volts and we have seen commercial instruments where this is done. However, most of the signals being measured will be of sine wave form and it is convenient to calibrate in terms of RMS values.

It is important to remember that the direct reading of the VTVM may have litle meaning if it is used to measure distorted waves but if the peak value is of interest, it can be calculated by multiplying the reading by 1.414 approx.

At high frequencies some factors we have not so far considered have to be taken into account. The lead connecting the circuit being measured to the coupling capacitor, the lead between the coupling capacitor and the plate (inside the valve envelope) and also the cathode lead all have some inductance. This can be accounted for roughly by the series inductance in the input lead shown in figure 3.

The plate-to-cathode capacitance of the diode valve and the inevitable stray capacitances can be considered equivalent to the capacitance shown in parallel with the diode in figure 3.

INPUT RESONANCES

These two stray quantities form a series resonant circuit and at the resonant frequency the reading of the instrument rises by an amount equal to the Q of the circuit due to the magnification across the capacitor.

It is not difficult to visualise other stray reactive components which will further complicate the behavior of the probe at high frequencies.

(The circuit of figure 3 is drawn as it actually is in the instrument. The 15 megohm diode load is split into two parts. The 5 meg. portion of the total resistance, between the diode and the capacitor, is the load for AC and, in conjunction with a bypass capacitor, acts as a filter to prevent the alternating current component being passed on to the DC amplifier.)

Another effect which has to be considered at very high frequencies is the time taken for electrons to travel between cathode and plate.

THE DIODE CIRCUIT EXPLAINED

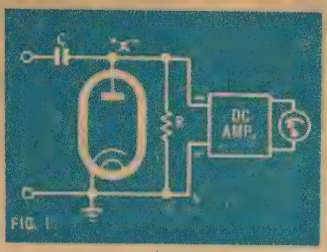

FIG. 1

The shunt diode rectifier reduced to its simplest form. This circuit has the disadvantage that the AC component of the input signal is passed through the cable to the DC amplifier.

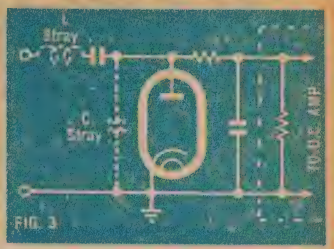

FIG. 3

Stray reactive components are accounted for here and the load resistor is split into two parts in order to decrease the input capacitance and filter out the AC component of the signal.

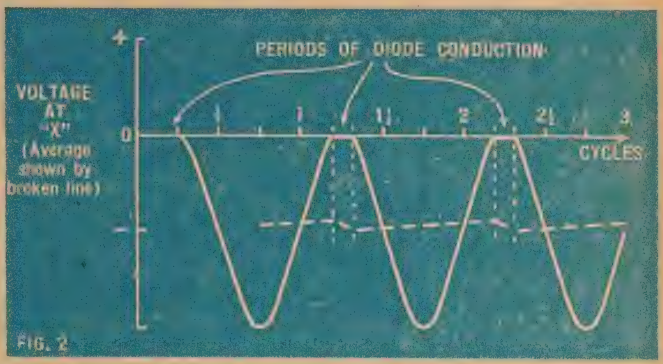

FIG. 2

Voltage waveform at the diode plate over the first few cycles after application of the probe. It is best considered as having AC and DC components superimposed. Note that the rectifier conducts for only a small portion of each cycle.

Errors due to this factor are small compared with errors due to other causes, in the case of this instrument, but it is worth noting that they do exist.

This brings us to more practical considerations and the factors which lead to the design of the two probe units described here.

The requirements for a valve to be used in a probe unit are fairly clear. In order to reduce loading on the circuit being measured at very high frequencies or with very high impedance circuits, the plate-to-cathode capacitance should be as low as possible.

A SPECIAL DIODE

At the same time the spacing between the plate and cathode should be small in order to reduce errors at high frequencies, due to the time taken for electrons to travel from cathode to plate.

The two requirements are in opposition but can be reconciled by reducing the area of the plate and cathode and placing them close together.

Due to the small power level in the diode circuit, the effect of such treatment on plate dissipation usually need not be considered but it is essential that such a valve be highly evacuated if the inverse breakdown voltage is to be retained with the close spacing.

The error due to electron transit time is directly proportional to both cathode-plate spacing and frequency and inversely proportional to the square root of the peak signal amplitude. In other words, the error will be greatest with small signals at high frequencies.

The response of germanium diodes also falls off at high frequencies although the mechanism is not quite the same as in the case of thermionic diodes. On the other hand, however, germanium diodes have decided advantages in respect of small physical size and small shunt capacitances, which make them very suitable for radio frequency measurements.

ADVANTAGES OF CRYSTAL

Yet another factor in favor of the crystal for reading low voltages is the excellent voltage/current characteristic in the very low voltage region. The rate of rise of current as the voltage is increased in the direction of conduction is greater than for a thermionic diode.

Against this, it must be remembered that a crystal has a relative-

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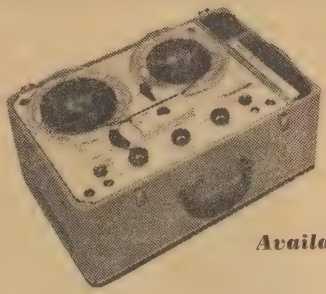

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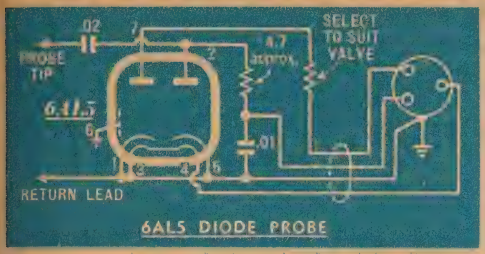
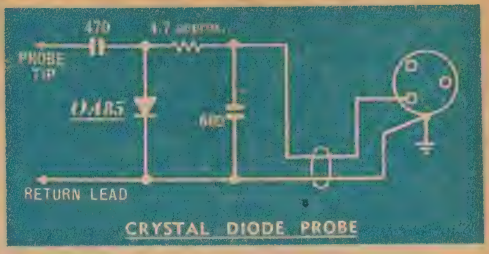


6AL5 DIODE PROBE

The 6AL5 diode probe duplicates the facilities provided inside the main instrument but with considerable reduction in loading. The series resistor for balancing should be selected finally after the valve has been aged.



CRYSTAL DIODE PROBE

Lower loading at radio frequencies is possible with the crystal rectifier due to its lower shunt capacity and smaller physical size. The rms input must be limited to 30 volts in order to avoid exceeding the rating of the crystal.

ly low peak inverse rating, is easily overloaded, suffers permanent damage, characteristics vary widely from crystal to crystal and individual crystals vary with variation in temperature.

Whether the detector be a crystal or a thermionic diode, there will be a further error due to the effects of lead inductance. The reading of the voltmeter tends to rise as the resonant frequency of the stray capacitances and series lead inductance is reached. The response due to transit-time effects falls at the same time and tends to reduce the error, but, since this varies with amplitude, it is ordinarily too difficult to calculate the correction.

With the foregoing in mind, we feel that two VTVM probes can be justified. The first, using a thermionic diode, for measurements on high impedance circuits generally and able to maintain calibration up into the medium radio frequency range. This probe is able to operate at high voltages.

The second uses a crystal diode and is more suitable for high frequencies, but it is not able to operate safely with input voltages above 30V. Both types of probes are described in this article.

Assuming a valve specially designed for the purpose and a carefully engineered probe, it is possible to extend the frequency response to about 500 Mc/s with small error. There are cases where every effort to obtain the ultimate in performance is warranted, but few VTVM users will consider the measures required for response beyond the 50 Mc/s or thereabouts with easily obtainable components worthwhile.

AVAILABLE TYPES

There are a number of diode valve types well known to experimenters. The older octal based types would no longer be considered for a voltmeter probe on the grounds of physical size, quite apart from interelectrode capacitances and lead inductances.

In the miniature range, types to be considered are the EA50, well known to users of disposals equipment and still available through the valve companies as a standard line, the 6X2/EY51 a type which was designed for television EHT rectifier service (also purchased through the normal channels), and, finally, the 6AL5/EB91.

The first two are single diodes. The EA50 has a limited voltage rating, but would probably be satisfactory in a VTVM where the full-scale voltage on the highest range is applied rarely. The plate cathode capacitance is favorable at 2.0 pF.

The 6X2 has a more than adequate voltage rating, and only 0.8 pF plate to cathode capacitance.

The 6AL5 is a double diode with close spacing and the plate to cathode capacitance is about 3 pF. However, the capacitance between one plate and electrodes other than its own cathode is very small, so that the overall effect is fairly favorable when the valve is installed in a small probe.

The feature which finally decided us to use the 6AL5 in the probe is the second diode-unit in the single envelope which enables the effects of initial electron velocity, contact potential and so on to be balanced out. The considerations in this regard are the same as for the rectifier included in the instrument and discussed in previous articles.

OUR CHOICE

There is a confusing number of germanium diodes which could be considered for the crystal probe. With regard to the supply position, price and characteristics we chose the OA85. This type has characteristics which give a linear scale even on the three volt range and can, with considerable reserve at any temperatures likely to be encountered, handle input voltages up to 30V rms.

Most of the information you will need to construct probes similar to ours is given in the drawings and photographs. The probe housing used for the 6AL5 probe is marketed under the name "Jabel" and is 1in outside diameter by 4in long. The tip is supplied complete with a polystyrene moulding specially designed to keep the input capacitance to a minimum.

INSIDE THE PROBE

The space inside the probe housing is limited as is necessary for a probe with reasonable overall dimensions. It was found best to mount the coupling capacitor load resistor and balancing resistor for the second diode in the space between the probe tip and the terminals of the valve socket. A skirted valve socket, as shown in the diagram, is soldered between two brass strips.

To the opposite ends of these brass strips are soldered a pair of brass nuts. The screws which also secure the polystyrene probe tip provide a positive contact between the structure inside the probe and the metal housing as well as a convenient position to which the earth return lead can be attached.

Inside the probe there is just suf-

PARTS LIST

6AL5 DIODE PROBE

- 1 probe housing 4in long, 1in diam (Jabel).
- 1 connecting plug (Amphenol or Acme).
- 1 connecting cable, 4 wires.
- 1 6AL5 valve.
- 1 7-pin miniature socket with metal surround.
- 1 0.02 mfd (or 2 x 0.01) disc ceramic capacitor (Ducon or UCC).
- 1 0.01 mfd disc ceramic capacitor (Ducon or UCC).
- 2 2 meg. ½ watt high stability resistors.
- 1 0.7 meg. ½ watt carbon.
- 1 ½ watt resistor, 1 to 5 megs to be selected.

Crocodile clip, scrap brass, ⅛in diameter bolts and nuts.

CRYSTAL DIODE PROBE

- 1 probe housing 3½in long. ¾in diameter (University).
- 1 connecting plug (Amphenol or Acme).
- 1 connecting cable, 2 wires.
- 1 OA85 crystal diode.
- 1 680 pF capacitor.
- 1 470 pF bead capacitor (Ducon or UCC).
- 2 2 meg. ½ watt high stability resistors.
- 1 0.7 meg. ½ watt resistor.

Scrap sheet brass, 2 8BA bolts, 1 8BA nut.

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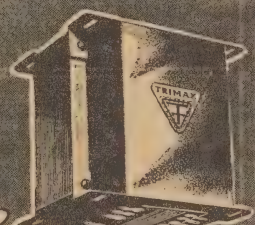

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ficient space to permit the passage of the three leads which must pass alongside the valve to the socket and components mounted between the valve and the tip. The remaining lead is an earth return and can be soldered to the brass strip near the top of the valve.

The components used inside the probe are worthy of special consideration.

In the case of the socket, the requirement is for high leakage resistance, low dielectric losses and low distributed capacitance. There are about six different miniature sockets available locally. The best are fairly expensive but the extra expense is justified in this case. We decided on a "Clix" socket fabricated in a wax-like material (Fluon) which has very low losses and a dielectric constant of only 2.

CAPACITORS

The coupling and bypass capacitors should be compact, able to withstand the applied voltage and with low series inductance. Of the capacitors available at present, a .01 mfd disc type employing a high dielectric constant material is the most suitable. Similar capacitors are available in several imported and two local brands but we suggest you check the matter of size before purchasing as space is limited.

The dielectric constant of the material is from 3000 to 5000 compared with the figure of 10 or thereabout for other often used dielectric materials. This results in a considerable reduction in physical size but is not without its disadvantages.

The capacity is likely to vary with temperature and applied voltage and dielectric losses are high compared with other materials. However, the impedance of the capacitor in this circuit is low compared with other impedances.

The voltage rating is nominally 500. It is customary to factory test

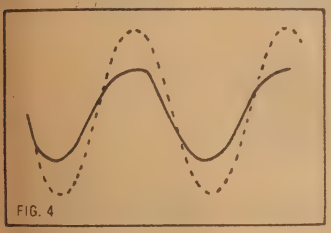


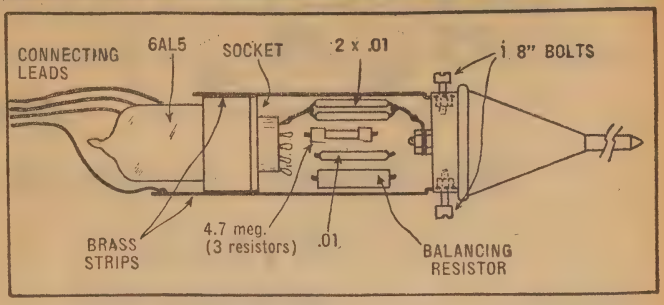
FIG. 4

The connection of a probe may alter both the amplitude and the waveshape where the signal source has a high internal impedance. This is an extreme case where the source impedance is 1 megohm. The unloaded signal is shown by broken line.

the capacitors at approx. three times this voltage and therefore unlikely that a breakdown will occur up to the 1000 V to which the instrument is calibrated, provided the reading does not occupy more than the usual several seconds.

For the load resistor, a high stability unit is desirable since its value affects the calibration. At the same time it should be small physically in order to reduce the capacitance between the body of the resistor and earth.

MECHANICAL DETAILS OF PROBES



Layout of components inside the 6AL5 diode probe. There is little space to spare but a small mounting strip near the tip end of the probe is desirable to support the connections between two of the outgoing leads and internal components.

The ½ watt types are only available in values up to 2 megohms and, in view of this, our suggestion is that you use two 2 meg high stability resistors in series plus one ordinary resistor of approx. 0.7 meg to make up the required value. The last can easily be varied in order to provide the correct calibration.

The remaining resistor corresponds with the 5 megohm potentiometer in the balancing diode circuit inside the instrument proper. An ordinary carbon resistor may be used and the approx. value required to balance out potential shift installed initially but it is best to wait until the instrument has had a number of hours operation and the valve an opportunity to stabilise before choosing the final value.

SMALL PROBE

To obtain the full advantages of the crystal probe it is necessary to adopt a more compact construction. A suitable housing could be fabricated by those with mechanical facilities but we found it convenient to use a ready-made unit.

University Graham Instruments Pty. Ltd. have agreed to make a housing available to readers who would like to construct a probe similar to ours.

The outside diameter of the metal body of the housing is ¾ inch and the length 3½ inches. There is a metal piece with a hole to take the connecting cable at one end while the tip end insulating piece is turned from polystyrene.

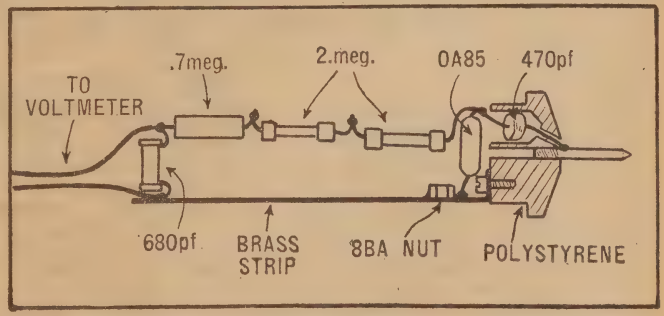
The small diameter metal tip as received was about 1½ inches long, ½ inch of this protruding and the remainder tapped into the polystyrene block and extending into the housing. A considerable reduction in input capacitance can be achieved by cutting the tip piece so that only about ¼ inch screws into the polystyrene.

The coupling capacitor is a 470 pF bead using the same dielectric material as before. A ¼ inch diameter hole was drilled into the polystyrene from the inside and to within 1/16 inch or so of the front of the block. It was positioned midway between the centre hole and the outside. Then with a very small diameter drill another hole was drilled at an angle to connect the bottom of the large hole with the probe tip where it emerges from the polystyrene block.

MECHANICAL DETAILS

Inside the probe a piece of sheet brass 1½ inches long and 3/16 inches wide with one end bent up ¼ inch is secured to the polystyrene block by an 8 BA screw tapped into the plastic opposite the original ¼-inch hole.

The assembly of the probe from this point on consists of passing the lead of the bead capacitor through the small hole and securing it to the probe tip. The length of wire between



Connecting leads involving probe tip, coupling capacitor, calibrating resistor and crystal rectifier can be made extremely short if care is taken. Use a pair of long-nosed pliers as a heat sink between body of OA85 and soldering point. The load resistor is made up of three small value units since small size high stability resistors are not available in 4.7 megohms.

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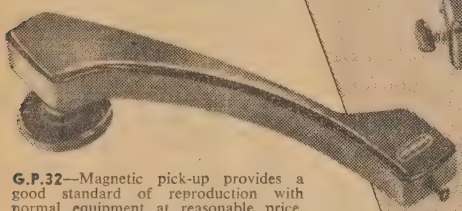

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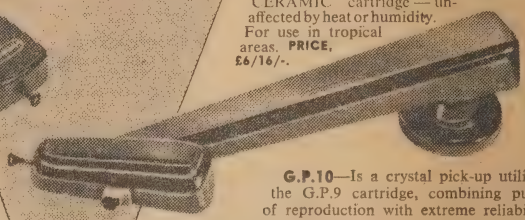

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the capacitor and the tip will be ¼-inch at the most.

The crystal rectifier can then be soldered between the other wire terminal of the capacitor and the metal strip, the leads on either end of the rectifier and the capacitor being only about 1/8-inch. The crystal is sensitive to thermal shocks and the wire between the body of the detector and the point of soldering should be held firmly with a pair of long-nosed pliers.

A point, essential to note at this stage, is that the crystal rectifier should be installed so that the direction of easy conduction is from the probe tip to earth. With the OA85 the white band end should go to earth.

LOAD RESISTOR

The load resistor, consisting of two megohm ½-watt high stability units and another ½-watt unit of approx. 0.7 meg is connected to the junction of the crystal and capacitor and positioned so that it runs down the centre of the probe housing in the complete assembly. The end of the metal strip away from the polystyrene serves as a return point for the 680 pF bypass capacitor and for the connection of the earth lead.

A positive connection between the metal strip inside the probe and the case is made by drilling through both case and metal strip and tapping the latter to take a small screw. With care in positioning the components the side of the connecting screw can be within 1/16 inch of the point of the lead from the crystal rectifier joining the metal strip.

With the components used it would be extremely difficult to construct a probe with lower stray capacitances and shorter leads. The measured value of the input capacitance at 1 Mc is, in fact, only 2 pF which is very low considering the manufacturers rate the diode alone as having a shunt capacitance of 1 pF. (Probably a conservative figure.)

The return circuit for the crystal probe can be made by connecting with the screw tapped into the support strip. For measurements towards the upper limit of the probe's range we suggest that a special return lead as short as possible be employed for each measurement but for work at lower frequencies a short length of hook-up wire terminated in a crocodile clip would make for convenience.

VHF BEHAVIOR

The significant components of the equivalent circuits of the probes becomes so involved at high frequencies that it is not worthwhile attempting to draw an equivalent circuit.

The frequencies at which these stray components become significant can be determined by noting the variation in output with frequency. In our own case the probes were connected across the terminating block of a VHF signal generator, known to be accurate, with leads appropriate to the case.

Tests on the basic instrument using the internal diode were carried out using the normal test leads being about 2ft 6in long and terminated with test prods. As the graph shows there was a violent departure from the correct calibration at 10 Mc and at frequencies higher than this the readings are of little interest, except on a comparative basis.

Readings were taken up to 200 Mc and it is worth noting that there is another peak above the reference line between 100 and 200 Mc. If time had permitted and there had been any worthwhile reason for so doing, it could probably have been proved that the characteristic of this latter peak varies widely with the layout and length of the test leads.

The conclusion to be reached from this is that the instrument with internal diode is likely to give a correct reading of the voltage applied between its terminals at frequencies up to about 10 Mc. However, for reasons of loading which will be discussed later we do not recommend that it be used for quantitative work on high impedance circuits above about 0.5 Mc.

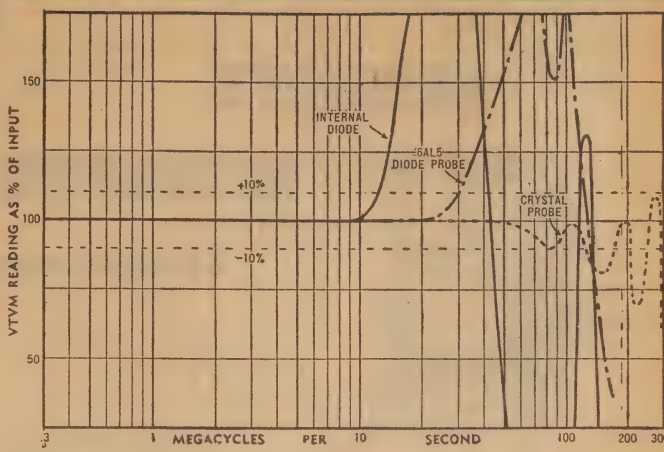
Even at lower frequencies, where high impedance audio amplifier circuits are involved the probe is to be preferred.

LABORATORY CHECKS

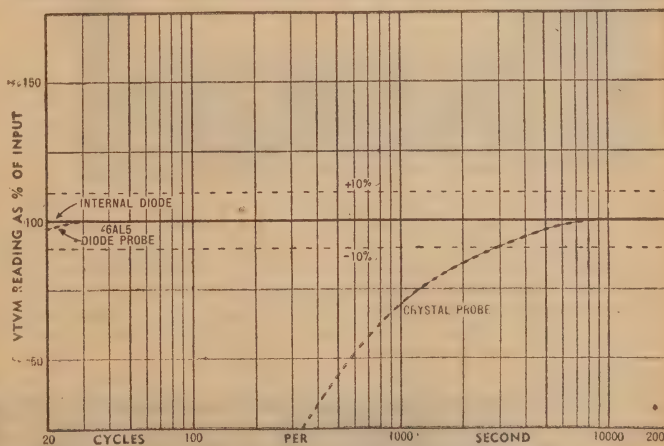
For checks on the 6AL5 diode probe, the tip was touched against the "hot" terminal of the signal generator terminating block and the return circuit made by means of a length of flexible hook-up wire about 6in long and a spring clip. This would correspond reasonably well with the arrangement likely to be used in this case.

As you will note from the graph, the calibration holds to about 25 Mc.

FREQUENCY RESPONSE OF PROBES



The readings of the vacuum tube voltmeter probes at high frequencies are expressed here as a percentage of the correct reading and plotted against frequency. A low impedance source was used so that loading is not taken into account.



At low frequencies the crystal probe gives lower than the correct reading. This is due to the small coupling capacitor used. In both high and low frequency cases, the tests were made at low signal levels.

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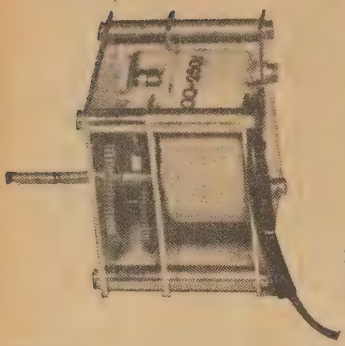

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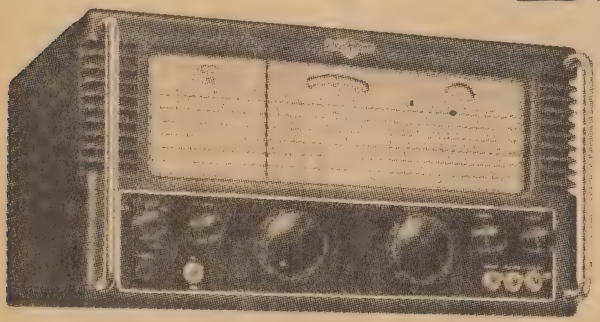

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Above this frequency the departure from the 100 pc line is so great that the readings are of no interest for measuring purposes but it is worth noting that they are not as much in error as with the internal diode.

The conclusion to be drawn is that any diode probe constructed according to the specifications we have given is likely to read correctly up to 20 Mc.

We emphasise that this does not mean that the probe will not disturb the circuit being tested at frequencies within its range. In fact this same probe could vastly alter the performance of a high impedance audio amplifier even at 1000 cycles/sec.

CRYSTAL PROBE

Checks similar to the above were carried out on the crystal probe, this time with the return lead between the VHF generator termination block and the body of the probe as short as possible. (Approx. ½-inch).

No measurable variation from the correct calibration was noted up to 50 Mc while the readings were within a 10 pc tolerance up to about 120 Mc. The graph provides a more detailed story than can be given in words but considering the usual tolerances of measurements made at these frequencies, we count the crystal probe useful up to almost 300 Mc.

Due to the limited output of the VHF signal generator used, the high frequency checks on the probes were carried out at a fairly low level.

An audio signal generator known to be accurate was used to make checks on all probes at the low frequency end of the range. At the lowest frequency of the audio generator, 20 cps, the fall off of both the internal diode and the probe is negligible. In fact, with the probe, the coupling capacitor could be reduced to .01 mfd and the response still stay within the 10 pc figure.

If your own requirement is to reduce the loading at high frequencies as much as possible you may decide to use the .01 mfd coupling capacitor. With the style of capacitor used in our laboratory model the input capacitance of the probe was reduced from 11 pF to 9 pF by omitting the second .01 mfd unit.

AUDIO RESPONSE

Because the coupling capacitance is only 470 pF the response of the crystal probe falls off steadily below 10 Kc. This is of no importance since the impedance of the 6AL5 probe is high at this frequency. In fact the small value is an advantage when the probe is applied to circuits with a high DC level since the shock due to the charging current through the crystal is lessened.

If you have no facilities for calibrating the probe at a frequency above 10 Kc, the best plan is to connect a large capacitor, say 0.1 mfd, across the 470 pF capacitor temporarily and carry out the calibration at 50 cps.

We now come to a question of vital interest to designers and users of vacuum tube voltmeters, being the effect of placing the probe across a high impedance circuit.

The input impedance of the VTVM is not easy to determine. It varies markedly with frequency and to some extent with the amplitude of the applied signal.

At lower frequencies the inductive components of the probes are small enough to be neglected and as far as external circuits are concerned the probe may be considered as a resistor and a capacitor in parallel. The problem is to determine the value of each.

THE METHOD

An outline of the method by which we arrived at figures for the input impedance will be of interest to readers who consider checking their own instruments.

As we pointed out earlier, the resistive component of the input impedance is not a simple function since it varies over the cycle. For this reason and because the reactances involved are so high, measurements by the usual bridge methods and methods involving measurements at two frequencies and the setting up of two equations involving the two unknowns and solving them simultaneously are not suitable.

The most suitable method appears to be to set up a Q meter, measure the Q of the inductors supplied with the instrument at a suitable frequency (We chose 1 Mc) and then note the Q with the probe connected.

The change in capacitance required to maintain the frequency constant is a direct measure of the input capacitance of the probe and can be obtained with good accuracy from the dial of the Q meter.

The resistive component of the input impedance of the probe can be calculated from the two Q meter readings. Because of the "flywheel" effect of a tuned circuit, the peak current drawn from the tuned circuit over the portion of the cycle when the probe presents a low dynamic resistance can be supplied. The value of resistance calculated from the Q meter readings is really an average and bears some relation to the practical application of the instrument.

TYPICAL LEADS

The readings with the Q meter were made with the leads etc, the same as for the frequency response measurements.

For the internal diode the input capacitance measured at 1 Mc was 20 pF and the shunt resistance .65 megohms. The significance of the statement of the frequency is that there will be some cancellation of the input capacitance by the series inductance. A measurement of capacitance at a lower frequency may show a higher value.

The resistive component is modified by the losses in various components notably the dielectrics of capacitors and is likely to be higher at lower frequencies.

Similar readings on the 6AL5 diode probe gave the figures of 11.0 pF and 1.2 megohms. Again the readings were made at 1.0 Mc.

For the crystal probe the input capacitance was measured as 2.0 pF and the resistive component 0.52 megohms.

(Continued on page 111)

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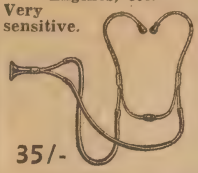

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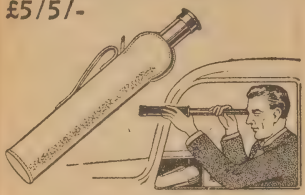

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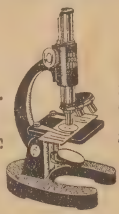

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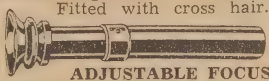

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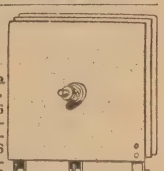

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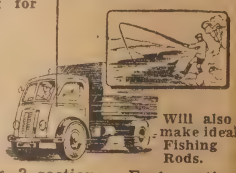

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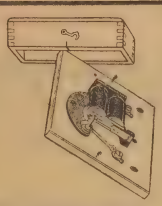

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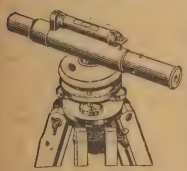

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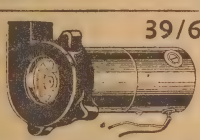

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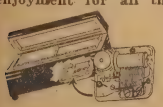

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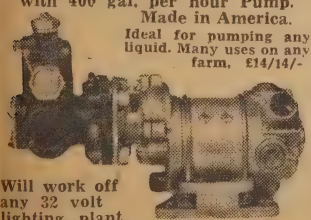

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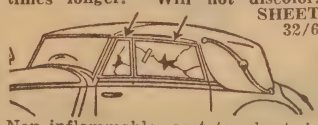

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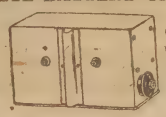

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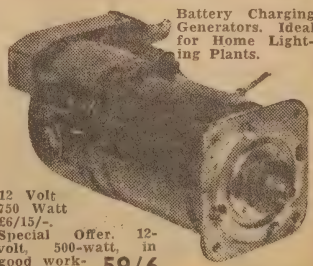

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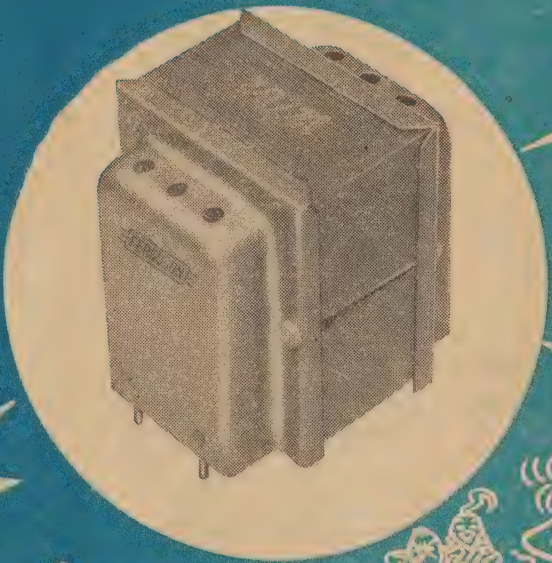

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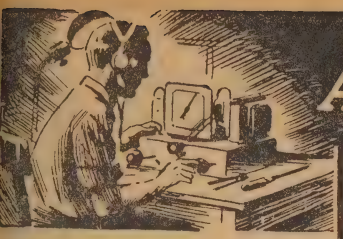


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

"REINARTZ PORTABLE" ADAPTED AS A BICYCLE RADIO

From Mr. D. S. Mitchell, 11 Playford Street, Glen Osmond, Adelaide, S.A., we have received details of the adaption of one of our circuits to be used as a bicycle radio.

THE circuit which Mr. Mitchell has used is that of the "Reinartz Portable" which was described in the March, 1953, issue of the magazine in the series "Teach Yourself Radio". He gives the following details of the set.

The only circuit alteration that was made was to replace the loop aerial with a normal Reinartz aerial coil.

The cabinet was similar to the original, except that it was made 4in deep instead of 3¾in. The aerial coil was positioned behind the place where the speaker is normally fitted.

When the set is used on the bicycle, the speaker is mounted in a separate box on the handlebars. If it is desired to use it in its original form as a portable, the speaker can be put back into the main cabinet.

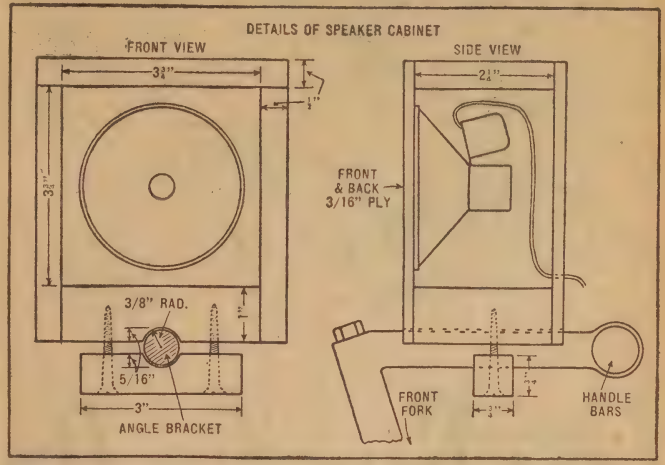
As the coil is now mounted in the place previously intended for the B-battery, a bracket was made to hold this battery in the top left-hand corner of the cabinet, facing front, and above the "on/off" switch.

A two-piece aerial 8ft long was used and this was obtained from disposals sources. The aerial enters the cabinet through the back right-hand corner of the cabinet. The hole is drilled so that when the aerial is in position it runs hard up against the right-hand inside wall.

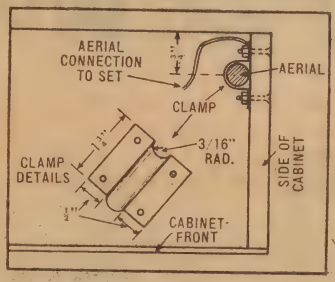
About 1¼in of the aerial protrudes into the cabinet and is clamped hard against the side with a U bracket as shown in the diagrams. By careful adjustment of the pressure between the bracket and the aerial, it may be made so that the aerial is easily removed if necessary. The aerial lead to the receiver is connected to one of the bracket mounting screws.

The speaker and the output transformer are mounted in a separate box the dimensions of which, for a 3in speaker, are 3¾in x 3¾in x 2¼in.

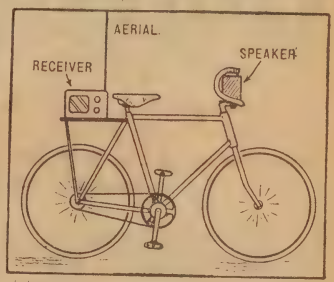
(Continued on Page 115)



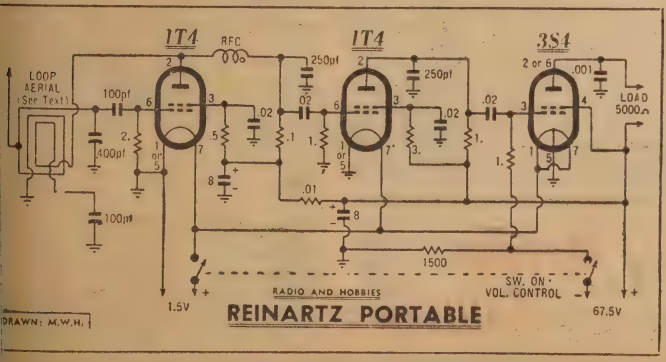
Details of the speaker box and the way in which it is attached to the handlebars of the cycle.



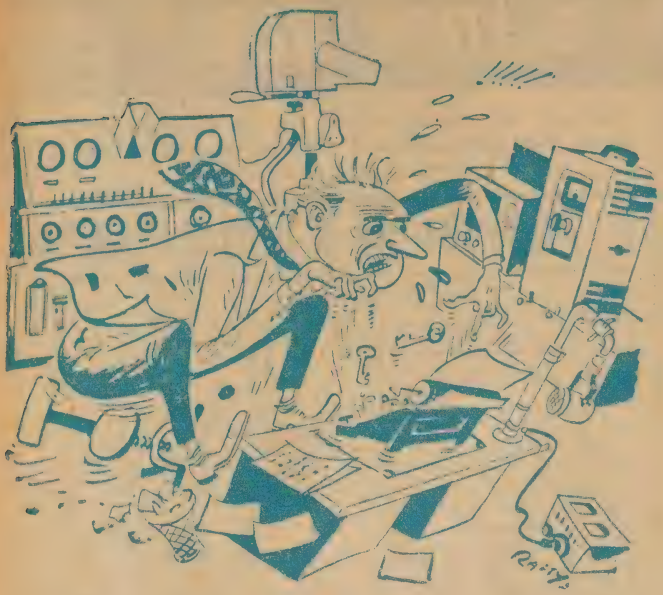
Details of the aerial bracket.



How the set mounts on the cycle.



The "Reinartz Portable" circuit adapted by our correspondent for his bicycle radio. It was described originally in March, 1953.



pression that the organ is a "bomb", far from it. It is really a nice organ to play with a very light electric action, and added to that, it is only about three years' old. Now this may appear a long and involved description above, but I merely wish to illustrate a typical state of affairs.

"But do not think that the electronic organ has it all over the pipe organ in parish churches. One parish up the North Shore line has an electric organ which is always giving trouble, and for which they are unable to obtain fresh parts from America.

AN OBJECTION

"But this is where I really voice my objection. Mr. Tarrant, who wrote the series of articles on electronic organs, suggested in a very casual manner in one of his articles that eventually the pipe organ would become extinct.

"Now my knowledge of electronics is not very great; in fact, it is virtually non-existent. But nobody can tell me that a whole lot of valves, inductances, toothed wheels, amplifiers and loud speakers can replace the town hall organ. I cannot conceive under any circumstances, Dr. Thalban Ball or Albert Schweitzer playing one of Handel's organ concertos on a Hammond organ. It would, coupled with a symphony orchestra, sound ridiculous.—Yours faithfully, J.E.C.

Let's Buy An Argument

I had thought that, for certain, remarks in the December issue about electronic organs would have called forth a howl of protest from champions of the traditional acoustic instrument. But nothing of the kind happened. The comments I did receive, were all remarkably tolerant of the current trend toward electronic music-making.

IN a way, this isn't surprising because the bulk of R. T, and H readers are radio-minded, and, if they aren't tolerant of electronic devices, then who else would be?

But, at the same time, a large number of readers are also interested in music for its own sake, and one might have expected from some of them, support for the traditional ways of producing it. But there you are—no letters of hurt or hate came to hand.

MIXED FEELINGS

One reader from Chatswood, NSW, certainly has mixed feelings on the subject. He concedes the possibilities of electronic organs, but cannot bring himself to imagine at least some of them being used to play serious music. He has this to say:

"I would like to put my head in the fire, as it were, concerning electronic organs and their utility as regards churches. As far as I can see they will replace the conventional 1, 2, and 3 manual pipe organs used in our churches today, if only for economic reasons.

"I play the local church organ every week and it is quite common to find that a note is jamming or the swell box won't close or some other minor fault has occurred. Rarely do these faults hinder to any extent the playing of the instrument, but they tend to be annoying. Consequently, the organ tuner has to be called out to attend to the organ, which all costs money.

"However, do not get the im-

by Neville Williams

To present the viewpoint of thos with fewer inhibitions about con ventional organs, we can do no bet ter than reprint a letter to han from another local reader-organis A.B.B.

Here's an enthusiast, indeed, wh doesn't believe in half measure He's not dismayed by the suggestio that an electronic organ "leaves th ordinary organ for dead". He doesn hesitate for a moment to suggest fo getting about ensemble effect chorus effects and "all that twad dle".

READ HIS LETTER

But perhaps you'd better brea off just here and read the lett for yourself.

The writer's enthusiasm for "beau tiful sounds" and his airy dismiss of ensemble and chorus effects hig light the cleavage between his pa ticular point of view and the wo

"organ" in its traditional sense.

Sooner or later, we'll either have to accept the word "organ" as describing any keyboard instrument producing multiple, sustained tones, or we'll have to find another word for organ-like instruments which don't conform to the traditional concept.

Maybe we'll need a whole range of new nouns to identify the products of the current and future research in this fascinating field.

Electronic instruments are certainly unrivalled in their ability to produce new musical sounds. They can range from the jerky-jive stuff to smooth, harmonically-rich cadences, which find no counterpart in the realm of acoustic instruments.

What is more, particular tone colors can be preserved over significant portions of the range, so that each note on the scale sounds remarkably like its neighbor. From this can spring delight or boredom, depending on circumstances and the listener!

NOVEL SOUNDS

Many a time I've been arrested by some novel tone color in a "pop" record, only to realise that the particular notes were being played on some kind of electronic this-or-that.

I think it's inevitable that the number of such electronic instruments must increase as the years go by. As I've already said, they are unrivalled in their ability to produce novel tone colors, as well as imitating traditional instruments—all via a keyboard and a set of switches.

And herein lies the second important point—you only need a keyboard and switches!

While there are clever people in the world who can play a variety of musical instruments, their numbers are few and far between—and little wonder.

An ability to manipulate the many gadgets on a saxophone has nothing in common with the skill necessary to play a trombone, or, yet again, to sort out the complicated chordings of a guitar or an accordeon.

(Perhaps I should have picked on more genteel instruments, but you know what I mean!)

Imagine the advantage of being able to simulate at least the majority of present instruments by simply throwing the proper switch and "doing your stuff" on a standardised keyboard.

"BRASS" BANNED!

It would, of course, rob the traditional brass band of its spectacle—in many cases the chief attribute. Just imagine a formation of gaudily dressed bandsmen, each with a small keyboard and loudspeaker slung from his shoulders; each trailing a long cord, leading back into the following power and amplifier. Yuck!

Or imagine a symphony orchestra consisting mainly of players doing one-finger exercises on little piano-like gadgets.

Technically, such a thing would be feasible. Musically, socially, aesthetically? I'm not saying!

All this, of course, is getting somewhat away from the original theme of organs but only in respect to manipulation.

Having learned to simulate a particular instrument electronically, or recreate the mythical "Lost Chord", it is only a matter of arrangement whether we build the facility into an "Organ" or produce an electronic solo trumpet or yet a full-range tempered-scale "Lost Chordeon".

To A.B.B. I can only suggest that there's no objection at all to his producing "beautiful sounds" in the privacy of his own home.

The more conservative of the tones might go over quite well in the local church, the more radical in the local dance hall. But I imagine that none of them would be very acceptable in a cathedral or a City Hall, where one expects to hear organ music of very, very traditional qualities.

Chorus? Ensemble? Mais Oui!

Just in passing, I note that a writer in the latest issue of *Audio* has this to say about the future of electronic organs in the US:

"It is a safe bet at this moment that the next product of the electronic art scheduled for a boom in the manner of radio, television and high-fidelity sound is the electronic organ. The bet is safe because that boom has already begun, even though it is still just in its infancy and may never perhaps attain the pro-

HE'S KEEN ON ELECTRIC ORGANS

Dear Sir,—As a veteran electronic organ experimenter and builder and NOT a paper theorist, may I venture a few remarks which may or may not prove of interest to aspirants in the electronic organ stakes generally.

Firstly, I am in complete agreement with your technical editor, and he is certainly not—in this case—"sticking his neck out", far from it. After all, electronic music is an entirely new and wonderful field; so wonderful that I doubt if anything could give you a greater kick once you have achieved the supreme thrill of having built an "organ" capable of producing the beautiful sounds they really can produce.

WHY WORRY?

Why, then, should we worry about whether an electronic organ sounds like an organ or not. After all, the makers of the Hammond organ, a truly beautiful instrument, make no claim in this regard at all; in fact they make it quite clear that their instrument is an entirely new medium of musical expression, and so it is.

Who can deny, or honestly disclaim the potentialities of the Hammond when a master like Ken Griffin fully exploits it. Imagine, or try to imagine the same beauty of tone from an ordinary organ played in exactly the same style. No—electronic music is indeed an entirely new field, a new art; it can be moulded and shaped and expressed as we wish; its field is limitless.

"Leaves the ordinary organ for dead"; "the most beautiful music (sounds) I've heard," were common expressions to me years ago when my own efforts were finally rewarded. It was a ghastly looking object and the keys (from an old piano) were absolutely terrible, but I've seen fellows, and capable musicians at that, who needed a conk on the head before they could be prised away from the thing. It seemed to prove one thing: electronic music has IT—and how.

What is really needed, and some day will come about, is a simple instrument with a variety of tone color, which can be produced within or somewhere near the price range of an expensive piano. The one great drawback, understandably enough, to the popularity of this new medium, is the fantastic price of any of the present day instruments, and, of course, their complexity.

Another thing, too; why half a dozen manuals and a hundred and fifty stops. Surely we can reduce this beautiful instrument to simpler and more understandable proportions for the average man, that is—and isn't it the average man or individual that counts? The engineer unfortunately has much the same attitude or organ outlook as the old pipe organ die-hard with his paddock full of pipes complex.

Not everyone has the money or time to embark on monumental organ projects—and even the simplest organ takes a lot of time, perseverance, ingenuity, and a lot of know-how. But I'll say this, if anyone really wants to go ahead and build one—and if he has the know-how—then go ahead and build one, he'll be well and truly rewarded.

Forget about ensemble effects, chorus effects and all that twaddle you have to build one first, the simpler the better, if you want to stay out of the nuthouse.

YOU'LL LOVE IT!

Once you have educated those ions along the right channels, you'll really get a kick out of electronic music; it's got something, believe me, it's really got something. There are so many pleasing effects you can get—oh, but I could go on bashing your eardrums for hours.

One final word—if you love music and you have a yen to play the organ, as I did, or if it sort of appeals to you, then dig deep, brother—just dig deep and get cracking on the greatest technical adventure of your life.

And if this means anything to you—good luck—you'll need it; but it'll be worth everything you put into it—you see.—Yours faithfully, A.B.B.

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Mr. Apthorp in Repatriation General Hospital, Concord, writes:—
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61. OLD ENGLAND

58 OLD WATER MILL

63. NATIVE FISHERMAN

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MR. TARRANT CLAIMS HE WAS MISQUOTED!

Referring to Mr. J. E. Jung's interesting letter, which appeared in "Let's Buy An Argument" in your December, 1955, issue, I feel that I must fly to my own defence.

Taking his letter, or rather the salient features of it, paragraph by paragraph, I would like to correct at the outset his idea—expressed in the second paragraph—that I consider that the organ employing frequency division is superior to the types using separate independent L/C oscillators for each note.

Most certainly I advocated, on the grounds of economy, the construction by experimenters and home builders of organs resorting to frequency division, but Mr. Jung has overlooked my statement in the second last paragraph of page 77 of the October, 1955, issue . . . "so it is with electronic organs in which each note must be individually tuned—whilst tuning may present difficulties the finished job is, undeniably, a more 'human' instrument than the (mathematically) perfectly tuned one".

In the same article, several paragraphs later on, it was stated . . . "the same remarks apply to other organs of this type—notably Allen, Constant Martin and Thomas. These three are more difficult to copy, however, particularly the Allen and Thomas instruments which, in conjunction with being expensive, are, **in the writer's opinion, far and away the best of all the electronic organs he has seen and heard**".

I would say that this last sentence should clear up any doubts as to where my leanings are. (Incidentally, the electronic organ building firm — of which I am technical director — makes an organ using a separate tube (half triode) for each note, even though the economies of production lie, without doubt, in organs resorting to frequency division.

WHAT I DID SAY

To turn to Mr. Jung's next statement (the third paragraph of his letter) this is something I cannot let pass. He says . . . "In the September issue a number of makes of electronic organs is listed, and it is then stated that "Allen, Constant Martin and Connsonata organs use individual tubes for each note, the remaining makers resorting to frequency division".

He then goes on to say ,"I cannot let this impression go unchallenged, as it is contrary to the facts".

Nor can I let this impression go unchallenged, &c.!

Mr. Jung has pulled a sentence out of its context, and turned the statement, primarily correct, into a misstatement. May I requote what WAS said in the article?

"In the USA, the most publicised are the Allen, Baldwin, Connsonata, Lowery and Minshall organs, and in Great Britain, the Constant Martin, Jennings, Lincoln and Maestrovox." Then comes Mr. Jung's extract, but in incomplete form, "OF THESE Allen, Constant Martin and Connsonata use individual tubes for each note, the remaining makers resorting to frequency division." . . . I underlined those two vital words which make all the difference, and which were left out by Mr. Jung.

However, from here on Mr. Jung and I are in complete accord; he obviously knows what he is talking about, except in the matter of key clicks in the Minshall organ. Several of the Minshall Organs are known to the writer—particularly their models E and J—and I have had many happy hours at their consoles.

NOT NOTICEABLE

Key clicks are practically non-existent; anyway, are not noticeable unless pointed out. The Hammond electric organ has a far more noticeable click in my opinion.

This, however, is only a minor point, but it does bring me to one more thing I would like to say in defence of the use of frequency dividers in home-built organs, other than on the grounds of economy.

How is it that so many thousands upon thousands of commercial instruments, using frequency dividers, have been and continue to be sold? The reason is that they are beautiful musical instruments, capable of almost ethereal tones that cannot help but delight.

There will always be a market for them, too since, after all, how many of the purchasers of these organs—particularly when the instrument is destined for homes and places of entertainment—know anything about organ lore?

The "purist" will not accept them, but he will, nevertheless, admit to their being a fairly satisfactory substitute, especially when £sd comes into the question.

The best electronic organ the writer has ever heard is the Allen Model B6 an instrument that even the most biased critics could not distinguish from a cathedral organ. This organ costs the equivalent of £A10,000, and leaves nothing to be desired, absolutely nothing, and must be acceptable to the most pure purist.

NOT PROHIBITIVE

However, can he afford it? Not likely! But he can afford £800 for a reasonably satisfying second cousin to such an instrument or £2500 for a really charming first-class organ—even if the sound does come out of loudspeakers (five of them).

In closing, I would like to publicly eat "humble pie". Over the years I have had more than a nodding acquaintance with commercial organs using reeds for basic tone generation. Back in 1935 there was the Everett Orgatron, in the mid-1940's there was the Minshall-Estey organ and latterly the Wurlitzer series, more especially their model 44, a very nice instrument, indeed.

None of these instruments is available in this country, so this is not an advertising plug! However, I have always regarded reeds as being somewhat "woolly" in the bass, and all of a oneness in the treble. I even said so in my articles in the June and August issues (1955) of this magazine.

Since then, however, I have had the opportunity of seeing a splendid Australian-made organ which has made me revise this opinion. To me, Wurlitzer 44 epitomised the best that could be got from reeds. Frederick Kilner and Sons Pty. Ltd., of Melbourne, have developed an organ, based on this principle, which, in my opinion, leaves the Wurlitzer far behind in both bass and treble response.

This organ should be accorded a place on the records as another Australian achievement, and it is for this reason that I would appreciate its mention.

Yours faithfully,

R. A. B. TARRANT.

---

ortions of the high-fidelity market.

"All of the companies in the field, rincipally occupied for years only ith selling to churches, now make pinet and medium-sized organs for ie home—and are selling them by ie carload.

"Complete kits are becoming available for home construction of organs nd new companies, sensing the rowing demand, are entering the eld with new designs.

"The consumer is finding that an nstrument with an ability to produce sustained tones with many different timbres is a fascinating or rewarding one to buy and, as in so many industries before this one, his discovery is working a metamorphosis."

I take it that the writer refers in this last sentence to a metamorphosis in musical approach.

To this I can only add that we can expect yet another metamorphosis (what a terrible word to type!) in the engineering side of things. To date, much of the development has been carried out by men who were primarily receiver or amplifier experts, with enough musical knowledge to evolve an organ as a sideline or extension of their interest.

But I can see a new electronic field in the making, populated by specialists in the game, just as there are specialists now in medico-electronics, industrial electronics and so on. The game's getting hard!

NEW SPEAKERS BY LEADING MANUFACTURERS

(6/9H) 6" x 9" OVAL PER MAG WITH 5T TRANS £1/15/-

(5C) 5in Standard-per-mag.—20/-
(5F) 5in Heavy Duty per-mag.—24/-

Available with 10T or 7T Transformer

POSTAGE & PACKING EXTRA: N.S.W. 4/6— INTERSTATE 5/6.

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NEW VIBRATOR POWER-SUPPLY

Input 6V. output 230V. at 50 MA. These units made by A.W.A. are free from hum or hash. Supplied complete with standard synchronous vibrator. **£3/15/-**F.O.R.

Electrolytic Condensers

12mfd 525 V -- -- -- -- 3/9
4mfd 600 V -- -- -- -- 1/9
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Heavy duty 12in per-mag speaker by well-known manufacturer. 10T, CT, or 5,000 Transformer. -- -- -- **£2/7/6**
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These New Vernier Dials are ideal for test equipment, receivers, etc.
(as used on AR8 sets)
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7in Dynamic speakers by leading manufacturer,
1,500 ohm Field Coil,
7,000 ohm Transformer
or
Ovaltone Dynamic Speaker
9in x 6in. 1,000 ohm
Field 5,000 or 7,000 ohm
Transformer
25/- EACH
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New small telephone generators, ideal for bell ringing, etc.
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CARBON RESISTORS

Color-Code Card-Supplied

Well-known make of carbon resistors in values of 100 ohms to 5 megohm. In 1-watt, ½-watt and 1/3-watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt 25 1/3-watt.
Price: Box of 100 .. .. **8/6**
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Power Transformers

New midget power trans. Upright mounting with cover plates. 240v. Pri. Sec. 225 x 225 at 50 Mill. and 6.3V at 3AMP **17/6**
Plus postage 2/6 NSW, 3/9 Interstate.

NEW INDICATOR UNITS

For that C.R.O. 10 valve 7.EF50. 1.879 1.EB34 1.5BP1
£8/10/-

I.F. TRANSFORMERS

Standard I.F. transformers, square can. (1⅜) 455K.C., permatuned. **3/9 each.**
Plus postage

CONDENSER SPECIAL

Boxes of 100 new mica and paper condensers in values ranging from 50pf. mica to .5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1, etc,
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Teletron Standard Octal Sockets (moulded bakelite)
3/6 doz.
Eight pin loctal sockets moulded
3/6 doz.
Six pin wafer sockets, **2/6 doz.**
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100 I.R.C. carbon resistors, ½, 1 & 2 watt. in values 50 ohm to 5 meg. including many popular sizes, 3T, 15T, 20T, 25T, 50T, 100T, 250T, 500T, etc., (Standard resistor color code supplied.)
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6 volt A.W.A. gas-filled vibrators. Heavy duty synchronous
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Plastic covered—6/9 per 100ft
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All in five mixed colors.
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Rothermel sapphire needles play 2000 recordings. Made in England. Each 2/9 or 25/- dozen.

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Standard ½ or 1 meg. switch pots long spindle d/p switch. **6/6**
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½ meg. or 100T. standard pots. long spindle -- -- -- -- **3/-**
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All plus postage.

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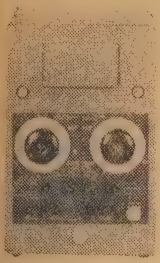
METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W.
PHONE LA6087

479 PARRAMATTA ROAD
LEICHHARDT, N.S.W., PHONE LM3610

A.R.8 COMMUNICATIONS RECEIVERS

Converted for 240v. AC operation
Including power-supply 9in x 7in Ovaltone Speaker



A.P.8 receivers are manufactured by A.W.A. and have a continuous coverage from 140 Kc to 20 Mc in six switched bands. Set contains 13 valves as follows: 3-6A8G, 4-6U7G, 2-6V6G, 1-6B8G, 1-6X5G, 1-6V4, and 1-6J7. Receiver speaker and power supply are fitted in attractive and durable plastic-covered instrument case which makes this unit complete and portable. On/off switch and tone control are also fitted.

£34/17/6 F.O.R.

NEW 5 VALVE D.W. MANTLE VIBRATOR CHASSIS

These Mantle Vibrator Chassis made by leading manufacturer have R.F. Stage and are supplied complete with Rola 9in x 6in oval speaker, valves and vibrator supply for 6 volt operation. Give good results on local, interstate and overseas stations with excellent tone.

CHASSIS ARE NEW BUT SHOPSOILED Ideal for building into caravans, boats, etc. Size of chassis, including dial, speaker and vibrator supply. 14in long x 10in deep x 14in high.

LIST PRICE OVER £40/-/-
SPECIAL PRICE £16/17/6 F.O.R.

NEW UNIVERSAL-MULTIMETER

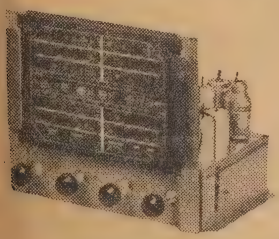
Manufactured by Robinson Electronic Laboratories Incorporating 4½in World Famous American Western Meter

This high-grade instrument is fitted in a durable and attractive hammertone-finished case with self-contained batteries and supplied complete with test prods.

D.C. Ranges	A.C. Ranges	D.C. Current Ranges	Resistance Ranges	Output Ranges	PRICE
0-12V	0-12V	0-1.5MA			£12/17/6
0-60V	0-60V	0-12MA	0-5,000 ohms	0-12V	Plus 12/6
0-300V	0-300V	0-60MA	0-50,000 ohms	0-60V	PACKING &
0-1,200V	0-1,200V	0-300MA	0-500,000-ohms	0-300V	POSTAGE

ALSO DECIBEL SCALE-18 to plus 5db.

NEW RADIOGRAM - CHASSIS KIT - SETS 5 VALVE DUAL WAVE



Complete kits of parts including 12in Magnavox or Jensen Speaker, five valves (1 6SA7, 1 6K7, 1 6SQ7, 1 6V6 and 1 6X5) and all other parts to the last nut and bolt to complete the five valve dual wave chassis illustrated.

These chassis when completed give excellent overseas, local and interstate reception as the coils supplied and intermediate transformers are high gain Permatune iron cored. Pick-up switch and volume control with A.C. switch supplied. Suitable for use with any crystal or high impedance magnetic pick-up.

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NEW AMERICAN TELEPHONE WIRE CLEARANCE

Rubber-insulated with stainless steel and copper conductors supplied on metal reels each containing half a mile of wire.

½-mile reels NOW 15/- Post Extra | **In case lots—6 reels (3 miles) NOW £4.**

RADIO ALTMETERS, TRANSMITTER RECEIVER TYPE RT-3A/ARN1.

Complete with the following valves:—5-12H7, 2-12H6, 2-12SJ7, 2-995, 2-9004 and one VR150. Midget 28V. Genemotor .. .. **£4/17/6** f.o.r.

NEW — RT34 APS13

TAIL END CHARLIE

12 Valve, 420 Meg Transmitter Receiver Gene Powered

6-UJ6, 9-UAG5, 1VR150, 2-2D2

£10

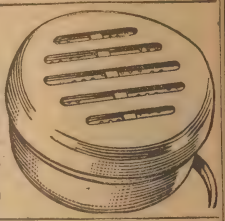
LESS VALVES, £6/17/6

PILLO-FONE

EXTENSION-UNIT

IT'S A REAL MINIATURE WITH ROLA UNIT

Install it anwhere, in the sick-room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3¼in Diameter by 1¾in deep. POST FREE **22/6**



NEW VALVES

807 .. 12/6		12SR7 .. 2/6	
7C7 .. .. 3/6	All Plus Postage	12SQ7 .. 2/6	All Plus Postage
7C5 .. .. 5/6		1T4 .. 10/-	
6K7G .. 7/6		KT61/6U7 7/6	
		1K5 .. .. 2/-	

OIL-FILLED CONDENSERS

20mfd. tapped	600V.	15/-	All Plus Postage
15mfd.	600V.	10/-	
4mfd.	600V.	5/6	
3mfd.	2000V.	15/-	
1mfd.	400V.	2/9	

RELAY-TYPE COUNTERS

("Mercury" American Made) These relay counters register from 0 to 99,999. Can be supplied with 250ohm, or 5,000ohm coils.

25/-

Plus Postage

P.M.G. TYPE RELAY-COUNTER

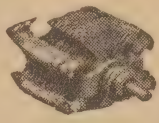
0—9,999.

1,300 ohm coil **15/-**

TELESCOPIC AERIAL

These new all brass 108 aerials measure 13 inches and extend to 5ft. 3 inches in five sections **15/-**

Plus Postage 2/6.



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Capacitance range 3-35 microfarad. Size 1¼ x 2¾ x 2¼ inches Brass plates: Ultra high frequency installation; ¼ inch shaft **8/6**

Price each .. ..

Packing and postage, NSW, 1/-; Q., T, and V., 1/6; WA, NT, 2/-.

24-VOLT MIDGET MOTORS SHUNT WOUND

Fully Laminated Fields. Wound Armature. Sixteen Segment Commutator, ball-bearing Armature. Ideal for Model Trains, Hobbyists, etc. Condition New.

Price, each **32/6**

Packing and postage: NSW 1/6; Interstate 2/6.

Transformer and metal rectifier to operate either of above. From 240V AC 30/-. Plus postage.

NEW FLEXIBLE DRIVES

Flexible drives to suit command transmitters or receivers 5ft 6in long .. .. **10/-** Plus postage.

To suit compass receivers 2ft long .. .. .. **10/6** Plus postage

NEW AMERICAN INDICATOR-UNIT

These indicator-units contain the following valves:

Six 6SN7GT, one 6G6, one 6H6, one 6X5GT, one 2X2, and 3BP1 C.R.O. tube which is fitted in a separate shield on a 4ft shielded lead and supplied with control box and plug; case and shield are finished in black brocade. In original cartons.

TRANSFORMER TO CONVERT THIS UNIT FOR 240 VOLT OPERATION AVAILABLE AT £3/-/- EXTRA, plus postage.

£8/15/- F.O.R.

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PHONE LA6087

479 PARRAMATTA ROAD, LEICHHARDT, .S.W.
PHONE LM3610

New Record Changers at Bargain Prices

New Stromberg-Carlson 3-speed Changer Model 104 with High Fidelity turn-over crystal pickup. **£14/15/-** F.O.R.

New English Garrard 3-speed Changers with High-Fidelity crystal turn-over pickup. **£14/15/-** F.O.R.

MIDGET GENEMOTOR

Input 28 to 32v at 1.1 amp. Output 250v at 60mA. New in carton.

£2/5/-

Used but in good repair.

£1/15/-

Postage extra.

Input filter supplied with genemotors

28-volt GENEMOTOR

Input 28 to 32v. Output 250v at 65mA. Used but AS NEW.

£1/5/-

Postage extra.

NSW 5/-, Interstate 11/-

AMERICAN RELAYS

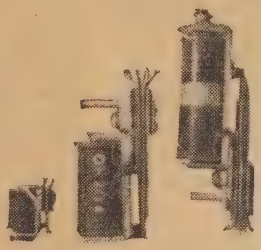
No. 1 Miniature relay 300 ohm coil, S.P.D.T. contacts, ... 7/6

No. 2 Standard relay 250 x 250 ohm coil 4 pole S.T. 7/6

2 pole S.T. 6/6

No. 3 Standard relay 15,000 ohm coil, 2 pole D.T., 12/6

All relays suitable for rewinding.



A.C. AMP METERS

A.C. Amp. Meters (ex-County Council). A necessity in any electricity workshop.

RANGE: 0-5 amps, (can be extended by shunts).

MOVEMENT. 300 degrees.

SCALE LENGTH. Nearly 15ins.

DIAMETER. 7½ inches.

28/6

Postage extra—NSW 6/6, Interstate 11/6.

H.F. Tuning-Unit

These H.F. tuning units which are suitable for the 144Mc. band contain three slug tuned coils, 7 plate ceramic trimming condensers, three acorn sockets (ceramic) and two new 955 acorn valves.

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PLUS POSTAGE

A.T.5 TRANSMITTERS

A.T.5 Transmitters supplied complete with valves (3-807 and 2-6V6).

PRICE .. .. **£4/17/6** F.O.R.

FULLAPHONES

Containing pair of headphones, morse key, buzzer key, switches, etc.

Post N.S.W. 6/6 interstate 8/6. **20/-**

6SH7 VALVES—TESTED 3/-

B.S.R. MOTORS

These English B.S.R. Motors as used on most tape decks also have many other uses. Size of motor 3" x 2½" by 2¼" deep with 3/16" shaft, for 240 or 110 volt AC. operation.

39/6 Postage NSW, 3/-. Interstate 4/6.

PLUGS AND SOCKETS

New 26-pin shielded plugs and sockets with silver-plated contacts.

5/- pair, plus postage

5-pin shielded plugs and sockets **2/9**

NEW METERS

0-1ma. 3in Flush Mounting with AC/DC Multimeter Scale ---- ---- ---- ---- **47/6**

0-10ma. 2in flush ---- ---- ---- ---- **15/-**

English 3in tuner, flush mounting. 10MA movement ---- ---- ---- ---- ---- **20/-**

ENGLISH 3in FLUSH 0-600V WITH SHUNT ---- ---- ---- ---- ---- ---- **20/-**

Postage extra.

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METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, NSW. PHONE LA6087

479 PARRAMATTA ROAD, LEICHHARDT, NSW. PHONE LM3610

TESTING SEMI-CONDUCTOR DIODES

Semi-conductor diodes may range from tiny "crystal" diodes to modern power rectifiers, each with its own distinct characteristics. This article, by Aerovox Engineers, discusses at length the testing procedures which can be applied to semi-conductor diodes intended for various applications.

THERE seems to be a growing impression that semi-conductor diodes can be tested adequately with an ohmmeter. This results from the fact that a DC ohmmeter will show a difference between the forward and reverse resistances of a diode or rectifier if its leads are swapped back and forth.

The unsuitability of the ohmmeter test as a sole check method lies in the fact that the meter voltage and current often bear no significant relationship to the rated DC parameters of the diode.

Thus, a diode may be checked as good at the ohmmeter voltage and still be unsatisfactory at the rated voltage, and vice versa.

Also, it very often is difficult to determine by this method the actual front-to-back resistance ratio of a diode, since the ohmmeter must be operated on at least two different ranges in order to read the values accurately. Switching the ranges not only changes the applied voltage but also the value of series resistance introduced by the instrument.

The consequent variations in applied voltage and load resistance change the operating point along the diode characteristic curve. Separate diodes also show the same effect, and the readings are meaningless unless all factors and conditions are known.

Another important consideration is that a diode might check satisfactorily in a DC test, ohmmeter type or otherwise, yet not be suitable for an intended application as an AC or RF rectifier or demodulator.

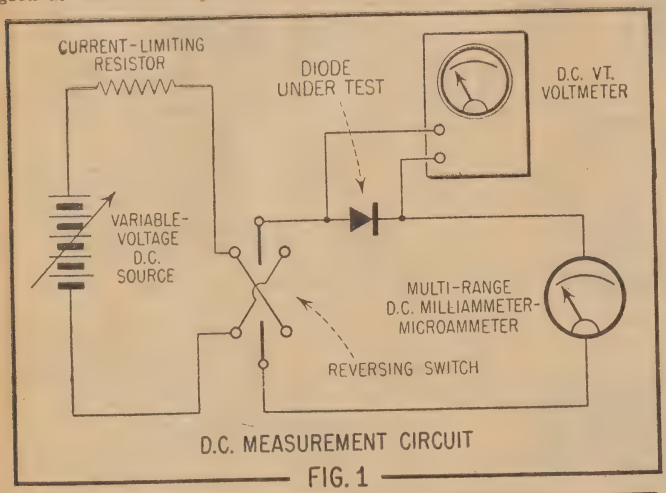
Use of the ohmmeter, therefore, is restricted to the simplest sort of initial test for separating good diodes from bad, since all that this instrument indicates reliably is that the component under test is a rectifier.

Two types of tests may be applied to semi-conductor rectifiers, whether crystal diodes or power rectifiers. These are identified broadly as DC tests and AC tests. There can be several categories in each type.

Basically, the DC test consists of passing a specified amount of current through the diode and checking the resulting DC voltage drop across the diode. The test is made separately, with the proper polarities, for forward and reverse conduction through the diode.

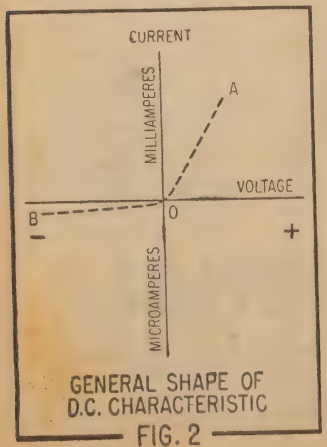
Note that this is the opposite of testing tube-type rectifiers, where the procedure is to apply a specified voltage and measure the resulting current. The DC test may be made at a multiplicity of points and a continuous static curve plotted from data taken at these points.

A short test consists of data taken at single forward and reverse check points specified by the diode manufacturer.



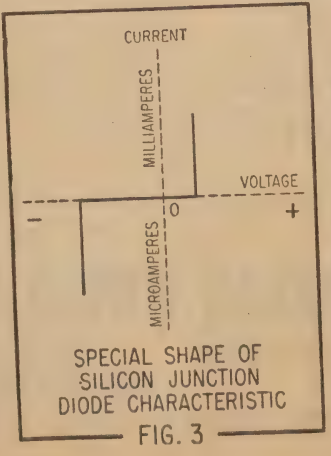
D.C. MEASUREMENT CIRCUIT

FIG. 1



GENERAL SHAPE OF D.C. CHARACTERISTIC

FIG. 2



SPECIAL SHAPE OF SILICON JUNCTION DIODE CHARACTERISTIC

FIG. 3

AC TESTS

AC tests fall roughly into two groups: (1) the **rectifier test** involves applying a given sinusoidal AC voltage to the diode and measuring the resulting DC output current; and (2) the **AM detector test**, in which an amplitude - modulated sinusoidal voltage is applied to the diode in series with an appropriate load resistance, by-passed at the carrier frequency, and the resulting modulation-frequency voltage measured across the load resistance.

Other special tests for certain diodes of specific types or for those intended for special-purpose applications will be described later.

As to which type of test is the most suitable, there is general agreement among semi-conductor engineers that a diode should be tested under the conditions that most closely approximate its intended methods of operation.

This does not necessarily mean that a diode which is to be used, for example, as a video detector must be tested in the actual TV receiver circuit (although that is not ridiculous). But such a diode should be given an RF instead of DC test.

Likewise, a diode, which is to be used as a meter rectifier should

given a low-frequency AC test. Conversely, a diode which is to be used in a direct-current application, for example as a polarity-sensitive element in series with a relay coil, should be checked at the direct current level at which it must operate.

Very little significant information could be gained from a DC test regarding the RF performance of a diode, nor could the RF test reveal what might be expected in the way of DC performance.

Figure 1 shows the apparatus setup for DC measurements. The variable-voltage DC source may be either a battery or a line-operated power supply. The reversing switch allows changeover of the DC supply polarity. The voltmeter and current meter also must have reversing switches, although not shown in the schematic.

CURRENT VARIED

First, with the anode of the diode under test biased positively for forward conduction, the current is adjusted to several levels within the safe operating range of the diode, starting at zero, by varying the voltage.

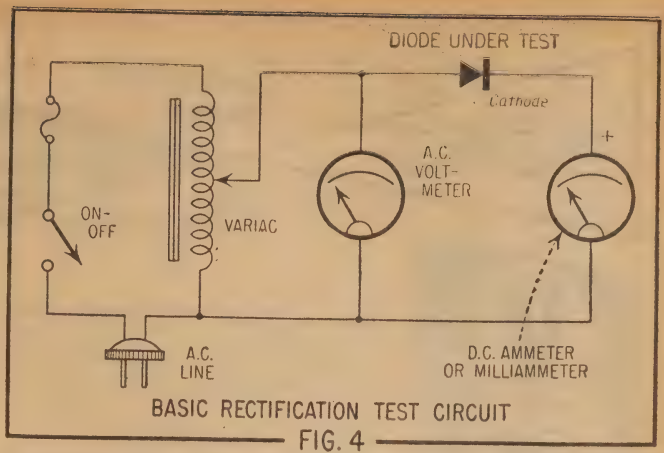
The current and voltage variations then are recorded.

Next, the reversing switches are thrown to bias the anode negatively for reverse (back) conduction and the procedure repeated.

The maximum diode voltages, both forward and reverse, and the maximum currents must not exceed the maximum **continuous** operating values given by the diode manufacturer.

The current and voltage data so obtained may be used to plot a static curve of the type shown in figure 2. The forward conduction characteristic extends from O to A, and the reverse conduction characteristic from O to B. Positive voltage values are low; negative values high. For small diodes, forward current is expressed in milliamperes and reverse current in microamperes; while for power rectifiers, forward current is in amperes and reverse current in milliamperes.

Figure 2 shows the **general** shape of a diode static characteristic. Various diode types show some departure, one way or the other, from this curve.



BASIC RECTIFICATION TEST CIRCUIT
FIG. 4

In gold-bonded germanium diodes, for example, section OA is steeper than in point-contact types. In germanium power rectifiers, OA is quite steep and OB moderately steep. The selenium rectifier curve has slopes which are intermediate between the preceding types.

SILICON DIODE

The silicon junction diode is a special case, its curve showing a characteristic such as figure 3. The forward current rises sharply at a particular value of positive anode voltage, and the reverse current similarly increases sharply at a particular reverse potential, called the Zener voltage.

The static characteristic curve is helpful when information is desired regarding behavior of the diode throughout its operating range. Obtaining such a curve by the point-by-point DC method, however, is laborious.

In many requirements for a diode acceptance test, a complete characteristic curve is not needed. In these cases, a single forward check and single reverse check will suffice.

The same apparatus setup shown in figure 1, or a simplification of it, is used but spot voltages and currents are employed. Most small diodes may be checked at plus 1 volt and minus 10 volts. When these diodes are to be used for blocking high reverse bias voltages, they usually are checked at minus 50 v or minus 100 v, depending upon type.

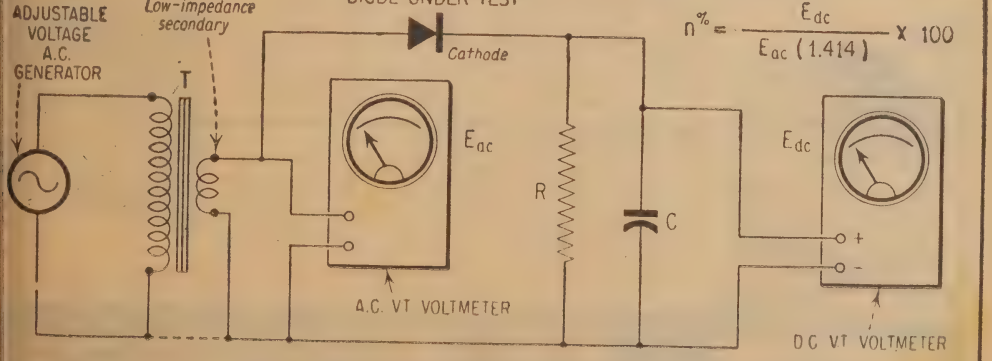
The main objective of the DC test is to determine whether the diode complies with current and voltage specifications. While under test, however, observations may be made of other important features which might render the diode unsatisfactory. These include current or voltage flutter current or voltage drift, heating, and intermittents.

In rectification tests, an AC voltage of required frequency and amplitude is applied to the diode or rectifier, and the resulting DC output current measured. Figure 4 shows the test setup.

VOLTAGE ADJUSTED

By means of the Variac, the applied AC voltage, as indicated by the voltmeter, is adjusted to the rated operating voltage of the diode. The output current is read from the current meter.

The latter will be a DC milliammeter for small germanium, selenium and silicon diodes, and an ammeter for power-type germanium



TEST CIRCUIT FOR RECTIFICATION EFFICIENCY
FIG. 5

acos

A COMPLETE RANGE

CRYSTAL MICROPHONES
MICROPHONE INSERTS

FOR EVERY PURPOSE

DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. **PRICE, £6/18/6.**

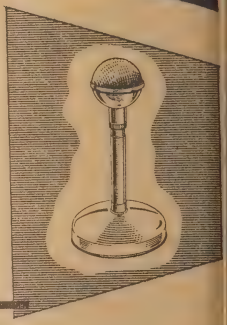
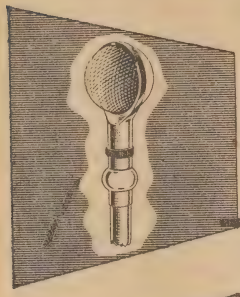


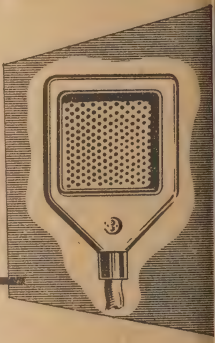
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



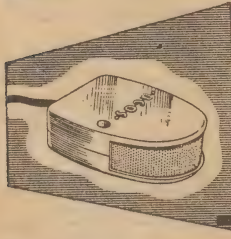
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lape. **PRICE, £5/19/6.**

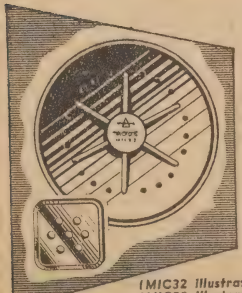


GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**

HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as $\frac{1}{8}$ in. square to 1-$\frac{1}{2}$ in. round, with various thicknesses from $\frac{3}{32}$ in. to $\frac{1}{16}$ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6;** all others, **£1/19/6.**

(MIC32 Illustrated)
(MIC23 Illustrated)

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elenium, silicon, copper oxide, and nagnesium-copper sulphide rectiiers.

At frequencies other than that of ıe AC power line the Variac must e one designed to handle the operting frequency. At high audio, and ıdio frequencies, a suitable adjustble-output signal generator may be ıbstituted for the power line and ariac. The generator output imedance must be low.

At high frequencies a VT voltıeter is needed to measure the pplied voltage.

In the rectification test the DC outıt current is noted when the applied ltage is the operating value specied by the diode or rectifier manuıcturer. The test is repeated at veral values of recommended load sistance.

The ability of a diode to function tisfactorily as a rectifier may be aluated in terms of the ratio of its C output voltage to an applied AC ltage. This ratio is termed **rectifition efficiency.**

ECTIFICATION EFFICIENCY

Rectification efficiency often is ecified in critical applications of rmanium and silicon diodes in mmunications and instrumentation uipment. Figure 5 shows the aıratus setup for measuring this ctor.

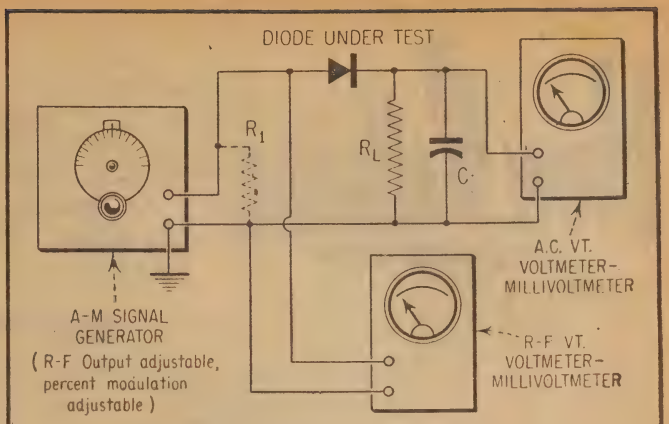
The test signal is supplied by a itable adjustable-output signal nerator through an isolating transmer, T. The output winding of s transformer has both low imdance and low DC resistance with spect to the diode forward resistce.

The type of transformer and its aracteristics depend upon the test quency. This unit will be ironed for audio and power-line freencies and will be of either airre, powdered-iron or ferrite-cord pe for radio frequencies.

The input voltage (Eac), indicated the AC vacuum-tube voltmeter, adjusted to the required level and DC output voltage (Edc), developed across the load resistance (R), read from the DC vacuum-tube ltmeter.

The required values of R and C ıally are given in the specifications the diode under test (a common mbination is R equals 5000 ohms, equals 20 mfd, f equals 10 Mc).

The rectification efficiency (n) ıals the DC voltage (Edc) divided the **peak** AC voltage (Eac x 1.414).



BASIC SETUP FOR A-M DETECTOR TEST

FIG. 6

Expressed as a percentage, this fraction must be multiplied by 100. Thus n equals 100 Edc/(1.414 Eac).

Rectification efficiency varies directly as the AC voltage amplitude, frequency and load resistance.

An important use of small diodes is in detector (demodulator) circuits. In this application the function of the diode is to separate the modulation component from the carrier component in an amplitude-modulated wave.

DETECTOR ACTION

Figure 6 shows an apparatus setup for checking detector action. The AM signal is supplied by a signal generator in which the output and the modulation percentage each are continuously variable.

Resistance R is a low resistance and is not required if the output circuit of the signal generator contains a low-resistance DC return path for the diode under test. The signal level is monitored by the RF vacuum-tube voltmeter-millivoltmeter.

The diode output, developed across the load resistance, RL, is monitored by the AC vacuum-tube voltmeter-millivoltmeter.

At a given value of modulation percentage and carrier amplitude the efficiency of the diode as a detector is proportional to the voltage indicated by the audio meter (AC VT voltmeter).

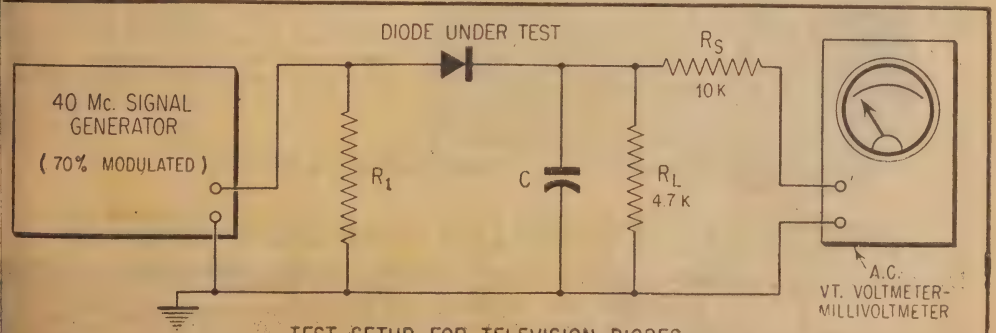
For a complete evaluation the test should be repeated at various signal-voltage and modulation-percentage levels and at several carrier frequencies. At low signal levels response of the diode will be observed to be approximately square law.

The value of load resistance RL usually is prescribed in the detector diode specifications. Capacitance C is chosen for effective bypassing of the carrier-frequency current component. If no value is specified for RL this resistance should be that value into which the diode will operate when installed in the equipment in which it is to be used.

ALTERNATIVE SET-UP

A variation of the detector test setup for TV diodes is shown in Figure 7. In this arrangement a 40 Mc 70 pc amplitude-modulated signal is applied to the diode under test. This is the arrangement suggested by the Joint Electronic Tube Engineering Council, JETEC.

The test procedure is the same as in the AM detector test described in the preceding section, except that the carrier frequency and modulation frequency are maintained constant.



TEST SETUP FOR TELEVISION DIODES

FIG. 7

New Release

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DUAL OPERATION mains or battery

The addition of two versatile mains and battery operated amplifiers to the extensive range of A.W.A. sound equipment provides for every requirement of mobile Public Address Operators.

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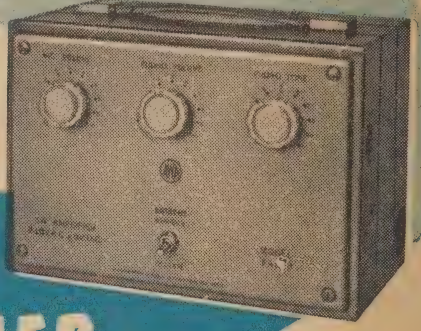
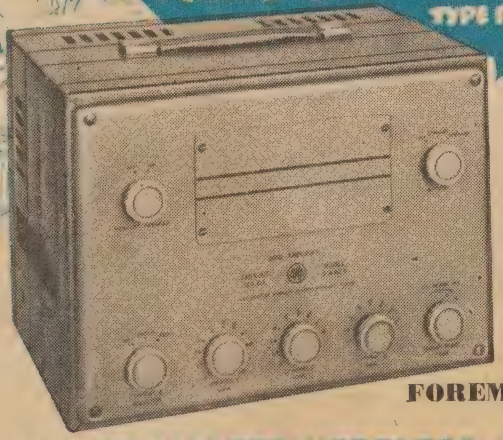
5 WATT AMPLIFIER

TYPE PA 828



20 WATT AMPLIFIER

TYPE PA 829



Type PA829 20 watt mains or 12 volt battery amplifier provides all facilities necessary for P.A. Hiring.

These include two microphone channels with third optional channel for microphone or pickup. Either high or low output pickups can be used. Features include a battery saving switch and a bass cut switch to control L.F. response when using horn speakers. A plug-in V.U. meter and monitor speaker with their associated switches are ancillary units.

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It was mentioned earlier that the production of a diode conduction curve, such as Figure 2, is a tedious process requiring the painstaking accumulation of current and voltage values point by point. It thus becomes costly, to evaluate a large number of diodes by this method.

A visual test method which is dynamic in nature gives a display of the complete curve on an oscilloscope screen. Figure 8(A) shows a circuit for visual display of the diode characteristic.

The diode under test is connected in series with an AC bias supply and a current resistor. This resistance is low with respect to the diode forward resistance, and usually is between 1 and 10 ohms.

During the half-cycle of applied 60-cycle voltage when the anode of the diode is positive, high forward current flows through the current resistor. During the negative half-cycle, the anode is biased negatively and small reverse current flows through the resistor.

VOLTAGE DROP

The voltage drop across the current resistor is proportional to the forward and reverse currents, and is applied to the vertical input of the oscilloscope.

Vertical deflection thus is proportional to current. The transformer output voltage is applied to the horizontal input of the oscilloscope. The horizontal deflection accordingly is proportional to the diode voltage.

The reason for using a DC oscilloscope is that the direct-coupled nature of its circuitry enables definite establishment and identification of the zero current and voltage point (origin) in the pattern. The horizontal axis may be calibrated in volts (forward and reverse) and the vertical axis in amperes, milliamperes, or microamperes (forward and reverse).

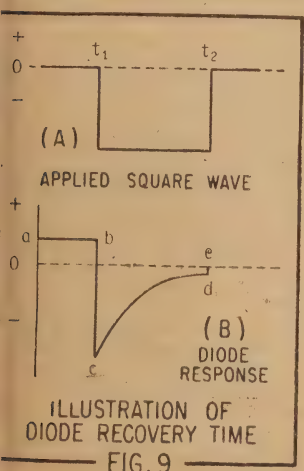

FIG. 9

Figure 8(B) shows typical patterns displayed by the curve tracer unit. Pattern (a) is the type normally obtained for a good diode.

The negative (reverse) portion of the changes its position intermittently, or **flutters,** indicating instability. This condition occasionally is observed also in the forward (positive) region of the curve.

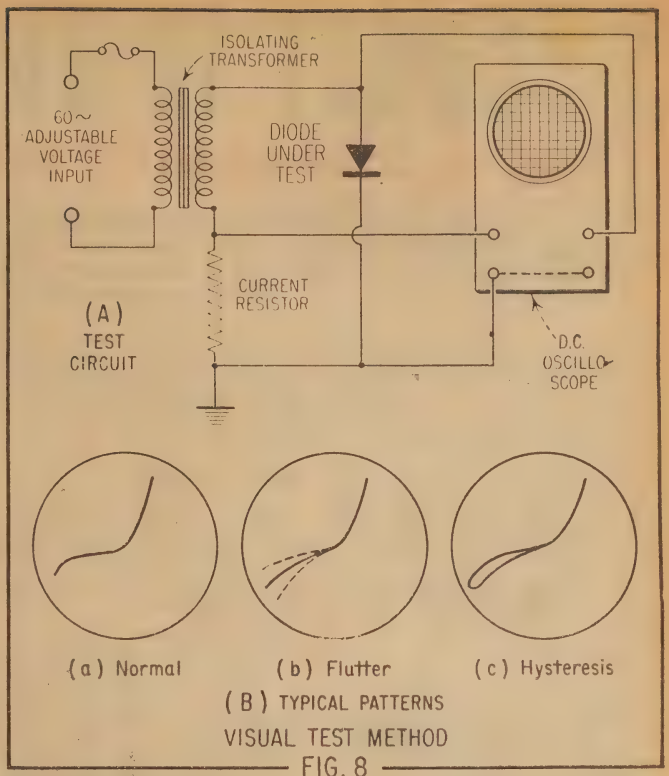

FIG. 8

In (c), the reverse portion of the curve is seen to be traced along one route from zero to maximum, but to return along another route from maximum back to zero. This opening-up of the curve is termed **hysteresis,** a condition which often foretells early failure of the diode.

A semi-conductor diode has the peculiar property that its reverse current will be relatively high (reverse resistance low) for an instant immediately after applying the reverse voltage **if the diode has just been conducting forward current.**

After this initial high-current transient, the reverse current then decreases gradually (resistance increases) to a value in line with the applied voltage. The interval during which the current settles to its rated level is termed **recovery time.**

RECOVERY TIME

Recovery time increases with the level of recent forward current. It is longer in junction diodes than in point-contact types. Short recovery time is particularly desirable in digital computers and similar pulse-type circuits in which diode conduction is switched rapidly from forward to reverse.

The wave pattern in Figure 9(B) illustrates diode reverse-current recovery effect. The diode conducts forward current during the interval from a to b. Instant b corresponds to time t1 (see Figure 9A). At b, a negative-going square wave of voltage (Figure 9A) is applied.

Because of its recent forward-current history, the diode cannot establish a high reverse resistance immediately, and, as a result, the reverse current increases instantaneously to c.

FALL TO ZERO

Subsequently, it decreases to d, and at time t2, follows the fall of the square wave back to zero. The time interval involved in the "recovery transient" is a matter of microseconds, the maximum being of the order of 10 microseconds for large-area germanium rectifiers and 1 or less for point-contact germanium diodes.

The depth of the initial current spike likewise is greatest with large-area germanium rectifiers and is least in point-contact silicon units.

Recovery time may be checked by applying a negative square wave (usually at a repetition rate of 100 kc) to the diode carrying forward current.

The diode current flows through a series resistor and the resulting voltage drop across this resistor is applied to the vertical input of a high-speed, direct-coupled oscilloscope adjusted to display one square-wave cycle.

The oscilloscope screen is graduated vertically in microamperes and horizontally in microseconds.

A COURSE IN TELEVISION

PART SIX—THE COMPLETE TELEVISION SIGNAL

Last month we studied the make-up of the video signal, involving the basic output from the camera tube and the synchronising pulses superimposed upon it. It now remains to see what follows when this total signal is modulated on to a high frequency carrier for purposes of transmission.

BEFORE we can study the question in any detail, however, it is necessary to assess the order of the modulating frequencies involved for, upon it depends the choice of suitable carrier frequencies and the bandwidth of the signal as finally radiated.

One might reasonably wonder whether the range of modulating frequencies will be less than, equal to, or greater than the usual 30-15,000 cps assumed in high quality sound broadcasting.

Whether the problems of selectivity, sideband cutting, loss of fidelity, &c., will be any more acute with video frequencies than with audio frequency transmission.

SIMPLE APPROACH

The answer to these questions can be sought in various ways, but the following approach should be as easy to understand as any. It provides an estimate of the range of frequencies involved.

We have seen from previous discussion, that the image is analysed and the scene re-created, in a modern television system, by the action of a finely focused beam of electrons scanning the image area.

In the Australian system, the image is divided into a nominal 625 lines. In practice, some of these lines are blacked out during the frame retrace periods, so that only about 588 "active" lines are disposed across the picture area.

WIDTH OF LINES

If the image area is to be analysed completely and the viewing screen fully activated, it follows that adjacent scanning lines must just begin to merge. In other words, the scanning spot will be focussed to a diameter approximating 1/588 of the image height.

With a circular scanning spot of this magnitude, it is obviously not possible to reproduce detail along any one line, smaller than the spacing between lines. In actual fact, experiments have indicated that equal resolution in both directions is a desirable quality.

If the picture were square, therefore, it might be considered that the maximum number of picture elements (or details) which could be resolved, would be 588 elements along each of 588 active lines.

In practice, however, the picture is wider than it is deep, by a factor of 4:3. Therefore the maximum number of picture elements per line will be approximately 588 multiplied by 4/3, equals 784.

This works out to a total figure of 460,992 elements for each complete picture.

Because of the interlaced scanning technique, complete information about the total picture area is presented to the viewer 25 times per second. Therefore, the maximum number of picture elements which the system can theoretically resolve each second is the abovementioned figure multiplied by 25, a total of 12,524,800.

This figure should not be taken too literally, of course, because it is derived from certain approximations. However, it does serve to indicate that a 625-line, 50-frame interlace system can produce (or utilise) each second, information about some 12,000,000 picture elements.

INTERLACE SYSTEM

Here one might pause to note the economy of the interlace system. To present complete information about each frame FIFTY times per second as for simple scanning, would involve the transmission and reception of information relating to more than 24,000,000 picture elements per second.

As it is, comparable detail can be resolved, without troublesome flicker, from only 12,000,000 picture elements per second—a saving of 2:1 in the amount of picture information which needs to be handled.

Naturally enough, this potential ability to resolve detail is not exploited along every line in every frame because, in a typical picture, there are substantial areas where the shading is quite even, and where the scanning spot does have to register any change as it passes over them.

In these areas the change in video is quite gradual and the resultant level frequencies are comparatively low.

The significant point is, however, that where fine detail or abrupt outlines are involved, the system can produce or use information about adjacent segments AT THE RATE of 12-million per second.

What does this possible RATE of PRESENTATION mean in terms of frequency—the quantity we set out to evaluate?

The answer can be derived in approximate fashion from figure 38.

The capacity of the system to resolve detail would reach its limit under the conditions indicated in sketch (a), where the spot travels

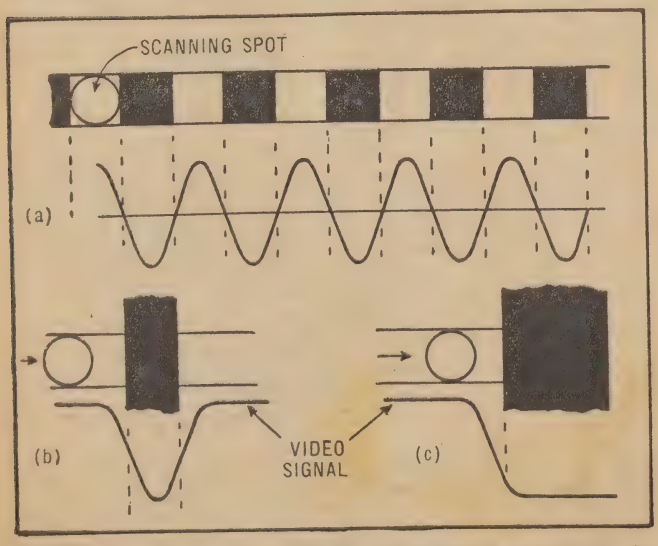

Figure 38: Illustrating the relationship between the size of scanning spot, the smallest picture "elements" or details which a system can resolve and the video frequency it produces while so doing.

line of black and white squares, aving dimensions comparable with e spot's own diameter.

On a white square, the video signal eaks in one direction. With the ot midway between squares, half hite and half black, the video signal lls to an intermediate value, actual- equivalent to what it would be ith the spot scanning a mid-grey rface. With the spot on a black uare, the signal peaks in the other rection.

Thus, in scanning two adjacent squares, each equal to the smallest picture element which the system can resolve, the video signal passes through one complete cycle of alternation.

Alternatively, one might construe gure 38a as indicating that each ntrasting picture element can pro- ce one half-cycle of video signal. Since we have shown that the stem can resolve picture elements T A RATE OF up to 12,000,000 r second, it follows that it will ll for video frequencies UP TO ,000,000 half-cycles or 6,000,000 mplete cycles per second. This is uivalent to 6 Mc per second.

XTREME CASE

If the image area were occupied tirely by a pattern similar to that visaged in figure 38a, the video gnal would comprise a rapid train waves (one for each line), roughly noidal in shape and having a funda- ental frequency of about 6,000,000 s—or 6Mc.

No practical image is likely to ke this form, even a test pattern ing a systematic grouping of con- asting lines and graded tones. How- er, it does not alter the fact that e system, where necessary, can solve picture elements AT THE ATE OF 12,000,000 per second and erefore involving video frequencies up to 6Mc.

In figure 38b the scanning spot shown as passing a fine black ne or an otherwise white surface. s it does so, it generates a single cle of a 6Mc wave. At the re- iving end, this one cycle of video gnal would darken the spot for e period taken for it to traverse s own diameter, thereby causing section of the line to be reproduced the viewing screen.

It follows that, if some inherent striction on the system prevented e single 6Mc alternation from aching the intensity grid of the cture tube, the line would not e reproduced.

LACK TO WHITE

Figure 38c shows an alternative uation where the scanning spot sses from a white to a black area d produces a half-cycle only of a Mc alternation as it swings the deo signal level from the "white" the "black" level.

At the receiving end, the scanning ot in the picture tube should be acked out in the same brief period time (a half-cycle at 6Mc), thereby oducing an abrupt white-to-black ge, only slightly less sharp than e outline in the original image.

Once again, if there were any striction in the system which pre- nted this brief 6Mc component om reaching the picture tube grid,

DETAILS OF TELEVISION CHANNEL

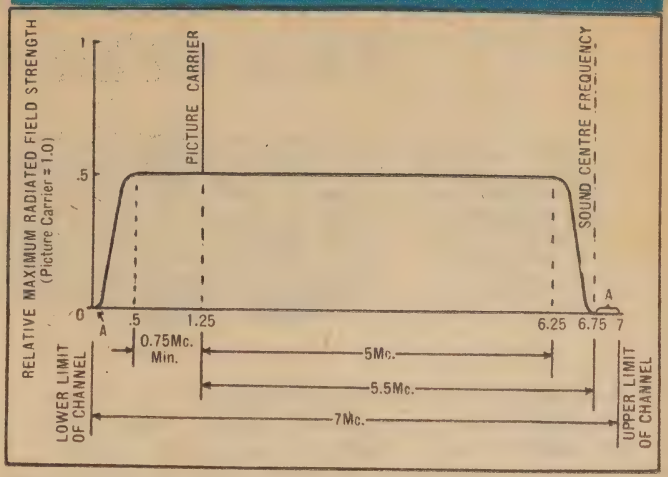

Figure 39: This diagram is referred to in the Standards Information as an "Idealised Picture Transmission Amplitude Characteristic". It indicates the position of the picture and sound carriers in such allotted channel, the distribution of sideband energy and the relative unmodulated amplitude of the picture carrier. Note that the lower picture sidebands are partially suppressed.

the change from white to black would be much less abrupt and the otherwise sharp edge would be blurred.

In saying all this we have extracted two vitally important and basic truths:

(1) An idealised 625-line 50-frame system can produce and utilise video frequency components up to an approximate figure of 6Mc.

(2) Any restriction on the transmission and reproduction of these extreme frequency components will degrade the final picture quality by losing fine detail and blurring sharp edges.

We are now in a position to make the comparison with sound broadcasting. Whereas high fidelity sound broadcasting calls for the transmission of AUDIO frequencies up to a limit of 15,000 cps, a good quality television picture requires the transmission of VIDEO frequencies ranging up to something like 6-million cps.

by Neville Williams

The loss of the higher audio frequencies in a broadcast receiver, either by sideband cutting in the tuner or by restrictions in the audio system, cause the reproduced sound to be dull or "mellow" by comparison with the original.

Loss of the higher video frequencies in a television receiver, either by sideband cutting or restrictions in the video amplifier system, cause the reproduced picture to lack sharpness and detail, very like an out-of-focus effect in a photograph.

Since this is a much more objectionable feature to most people than "mellow" sound reproduction, television receivers have to be designed and produced to much more rigorous specifications than routine broadcast receivers. The truth of this statement will become more apparent later in the series.

In the meantime, the need to convey to distant receivers video frequencies of up to six odd megacycles presents a very great problem. It is obvious that, if modulating frequencies of this order are involved, then the carrier on which they are superimposed must be very much higher again in frequency than 6 Mc (or 6000 Kc).

It means, in practice, that carrier frequencies lower than about 50 Mc cannot even be considered and that all transmission must take place on the VHF or UHF bands.

FREQUENCIES TOO LOW

There can be no question of transmitting television programs on the medium wave broadcast band, with its wide coverage, because the carrier frequencies involved are far too low to accommodate the requisite modulation.

However, even assuming the use of the VHF and UHF bands (respectively 30-300 and 300-3000 Mc) the extreme modulating frequencies required for television still lead to embarrassment.

In the ordinary way the process of amplitude modulation—the most economical in terms of bandwidth—involves the production of sidebands equal to the sum and difference of the carrier and modulating frequencies. Thus the addition of modulating frequencies of up to 6 Mc and a 50 Mc carrier would produce sidebands ranging in frequency from 44 to 56 Mc.

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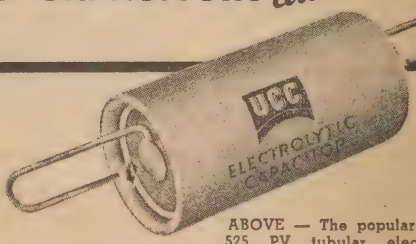

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carry the sound and "guard ands" to clear adjacent stations and ie can foresee a demand for some 3 or 14 megacycles of "ether space" or each and every television station a particular area.

But for the use of interlaced scanning, the requirements for each ation might easily have been double iis again. However, be that as it iay, a bandwidth of 13 to 14Mc per ation is excessive in an already owded spectrum.

ADDITIONAL ECONOMIES

This obvious difficulty has forced ie adoption of two additional conomies, both aimed at conserving andwidth. One involves some comromise in ultimate picture quality; ie other is a modification to the ormal process of amplitude modulation.

In the first place, the ultimate resolving powers of a high definition ystem are only realised if optimum onditions are maintained throughit the whole system between the riginal scene and the reproduced nage.

Imperfections in the original aterial, the camera, the studio quipment, transmitter, receiver, picure tube or even in viewing conditions, can all result in some loss of efinition, so that the viewer does ot see all the detail which the ystem can theoretically resolve.

Having respect to all these possible nitations and what can be regarded s a satisfactory end result, the andards specify a maximum video equency somewhat lower than anticipated by the foregoing calculations.

The Australian standards, which re in line with CCIR recommendaons, assume a maximum video freuency without attenuation of 5Mc. his figure still allows for better cture definition than is available n either the existing British or merican systems.

VESTIGIAL SIDEBANDS

If normal amplitude modulation ere used, video frequencies of this der would call for a total bandidth of 10Mc for the modulated icture carrier. In practice, however, is figure is further reduced by sing what is known as the "Vesgial Sideband" method of transission.

This is a variation of the "single deband" technique, which is often entioned in technical literature. hile it involves special design in e transmitter, the general idea is ot hard to grasp.

Filters are provided in the aerial rcuit and the tuning of the transitter so adjusted that the sidebands n one side of the carrier are atnuated. Since they are not comletely suppressed, however, the ethod of transmission is defined as "estigial sideband."

By adopting this course, it is posble to reduce the bandwidth requirements of the modulated signal om 10Mc, as previously mentioned, something less than 7Mc.

Modern practice is to allot each levision station a "Channel", hich is commonly identified by a mber as, for example, "Channel

The channel is a standard number of megacycles wide and is intended to accommodate the picture carrier and all its active sidebands, as well as an additional carrier for the sound signal, which must accompany the picture.

Figure 39, reproduced from local standards information, shows the disposition of signal energy required of each station within its own allotted channel.

Each channel is 7Mc wide and the picture carrier must be at a frequency 1.25 Mc above the lower limit of the channel.

When modulation is applied to the picture carrier, video frequency components up to about 0.75Mc must produce normal sidebands on either side of the carrier frequency.

These lower frequency components would represent the relatively gradual changes in video level as the scanning spot traversed areas containing little detail.

Video signal components higher in frequency than about 0.75Mc must produce sidebands energy only on the high frequency side of the carrier. Outer sidebands on the low frequency side must be suppressed so that no energy is radiated outside the lower limit of the prescribed channel.

On the high frequency side, sidebands which might otherwise extend more than 5Mc beyond the picture carrier frequency must be sharply attenuated. This leaves sufficient room at the high frequency end of the channel to accommodate the sound carrier.

This latter is centred 6.75Mc above the lower limit of the channel, therefore 0.25Mc inside the upper limit and 5.5Mc away from the picture carrier. All these "standards" must be strictly observed by the station concerned.

FM STANDARD

The sound carrier, according to local standards, must employ frequency modulation, the deviation for full moduation being plus and minus 50Kc. It must be capable of handling frequencies within the 50-microsecond pre - emphasis characteristic.

This is equivalent to saying that the treble response above 1000cps must be boosted during transmission by an amount equal to 10db at 10,000cps.

The treble pre-emphasis is therefore comparable with that used in microgroove records and a corresponding degree of treble attenuation is required in the receiver's audio system.

The standards specify many other things about the picture and sound signals, their spurious modulation content and so on, none of which need concern us here. If we have managed to assimilate the information contained in figure 39, it will be sufficient for present needs.

The next question is, of course, how many channels can be accommodated in the spectrum, remembering that numerous communication, amateur and navigational services are already in operation in the region above 50Mc. Unless such existing allocations are to be upset, television channels must be fitted in where they can best be accommodated.

The accompanying table shows the frequency allocations for the 10 VHF channels which have been tentatively allotted for television services in this country. It will be noticed that each channel is 7Mc wide, in line with figure 39.

In addition to these channels, space is available in the UHF band, from 500Mc to 855Mc, for 50 additional channels, each 7Mc wide. There is no immediate intention, however, to use these channels, the allocation being purely provisional.

The use of standardised "Channels", as described, makes for ease of operation at the receiving end.

AUSTRALIAN TELEVISION CHANNELS

Channel 1	49-56Mc.	Channel 6	174-181Mc.
Channel 2	63-70Mc.	Channel 7	181-188Mc.
Channel 3	85-92Mc.	Channel 8	188-195Mc.
(For use in inland country areas only)		Channel 9	195-202Mc.
Channel 4	132-139Mc.	Channel 10	209-216Mc.
(Available from July 1st, 1963)		UHF Channels are provisional only, 50 channels being envisaged between 500 and 855Mc., each 7 Mc. wide.	
Channel 5	139-146Mc.		
(Available from July 1st, 1963)			

SELECTIVITY CURVE

In practice, receivers are designed and adjusted so that their overall selectivity curve has a fairly flat top and is wide enough to admit the total 7Mc-wide band of frequencies radiated by the station concerned. (We shall be discussing this question in detail in a later issue.)

Modern television receivers use the superhet. principle almost universally and the selectivity curve is almost entirely dependent on the IF channel.

When the set is tuned to a station, its oscillator heterodynes both the picture and sound carriers, to produce two intermediate frequencies, 5.5Mc apart. Both pass through the IF channel to their respective detectors.

The picture IF, being amplitude modulated, is handled by an AM detector, while the frequency modulated sound IF is demodulated by a ratio detector or FM discriminator.

When it is desired to select another program, the local oscillator frequency is changed—by the act of tuning — until heterodyne action produces in the IF channel resultants from another station channel.

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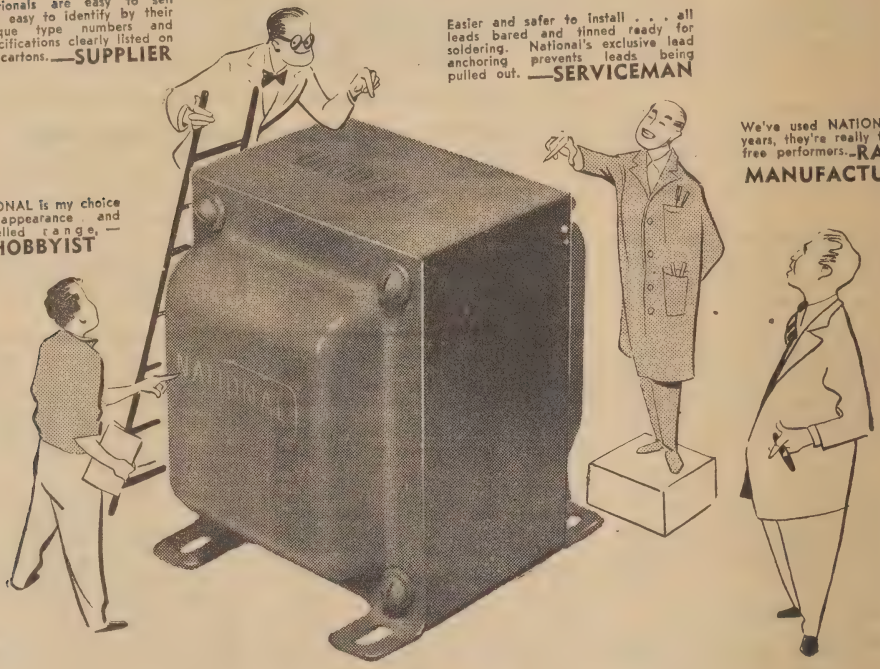

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Since the picture and sound carriers in each new channel are maintained in the same standard relationship, they produce the same result through the IF channel. The action of tuning the sound automatically brings in the picture.

So much for the disposition of signals in terms of frequency. A few additional points need to be made, however, in relation to the picture carrier and its relevant modulation.

Though we have related the rate at which the video frequency might change to component frequencies, it is important to remember that the video signal is not cyclic or repetitive in character.

VIDEO SIGNAL IS DC

As we pointed out in the last issue, the video signal is essentially a DC quantity which varies erratically according to the distribution of light and shade across the image area. Due account must always be taken as to whether positive or negative excursions represent highlights or shadows.

In exactly the same way, due account must be taken of the "polarity" of the video signal modulated on to the RF carrier.

This is a question which does not arise in ordinary AM broadcasting, because sound waves are more or less repetitive and symmetrical and there is no need to preserve any special phase relationship between the movement of the original microphone diaphragm and the instantaneous amplitude of the modulated carrier.

SIGNAL POLARITY

In the case of video signals, however, the connection between highlights and shadows in the original scene and the carrier amplitude is fundamental and leads to the adoption of two possible practices:

(1) Highlights may effect an increase in carrier amplitude. Black areas will therefore cause a reduction in carrier amplitude while the superimposed pulses, representing "blacker-than-black" may reduce the carrier to almost zero level. This is known as POSITIVE modulation and is depicted in figure 40a.

(2) Highlights may effect a decrease in carrier amplitude. Black areas will therefore cause a rise in amplitude while the superimposed pulses, equivalent to "blacker-than-black", will produce peak carrier level. This is known as NEGATIVE modulation and is illustrated in figure 40b.

Arguments can be advanced in favor of both systems, but, largely due to developments in receiver design, the weight of opinion is now in favor of NEGATIVE modulation. Britain, while Britain of necessity retains the original practice of positive modulation, most other countries, including Australia, have settled for negative modulation.

POSITIVE, NEGATIVE MODULATION

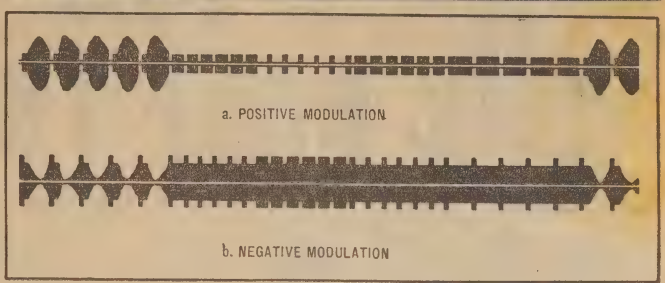

Figure 40: This diagram illustrates the difference between a television signal using positive modulation (a) and negative modulation (b). Note that in the latter case peak carrier amplitude occurs on the synchronising pulses.

Therefore, the modulation of all local transmitters is so arranged that shadows in the original image cause an increase in carrier amplitude, while peak amplitude occurs on pulses, as per figure 40b.

TRANSMITTER RATINGS

The non-symmetrical nature of the total video signal—that is, video plus pulses—necessitates another method of rating transmitter power.

In the case of ordinary AM sounds transmitters, the carrier power is specified as a certain figure, unmodulated. Metropolitan B-class stations may therefore be classified as using 5-kilo-watt transmitters. When modulated 100%, the radiated power will vary instantaneously from zero to four times the unmodulated value.

A television carrier, however, is never unmodulated. Even in the absence of any picture on the screen, the synch. pulses will be radiated in normal fashion, thereby producing peak carrier power at their repetition frequency. The signal level between these carrier peaks may be almost anything.

Even in the presence of picture modulation, the carrier level between pulse peaks may again be "almost anything", depending on the light and shade content of the image being radiated. The AVERAGE power of the carrier will vary with this video modulation level.

Obviously enough, the characteristic of a television signal which can best be rated is its peak power which, in the case of negative modulation, corresponds with the power radiated on the synchronising pulses. Hence the practice of rating television transmitters in terms of peak carrier power or amplitude and relating other quantities to this figure.

Usual practice, in specifying transmission standards, is to depict a great deal of the foregoing information graphically, with relevant explanatory notes. Space does not permit reproduction of the original Standards Drawings but figure 41 will serve to indicate some of the points which we have been discussing.

In actual fact, figure 41 represents graphically the result of modulating on to a carrier the video signal depicted last month in figure 37. It therefore represents the sequence of events over the same inter-frame period.

INVERTED SIGNAL

It will be noted that the video signal has been inverted in relation to figure 37 so that the pulse peaks extend upward to indicate peak carrier amplitude.

If this is regarded as equivalent to 100 pc of the station's licensed peak power, then the black level is seen to occur at 75 pc—a figure which must be maintained by the station within 2½ pc.

From 75 pc downward, the video level corresponds to increasing white until peak white is assumed to correspond with from 10 to 15 pc of peak carrier power.

It is important that the carrier never be reduced to zero because it would prejudice the operation of receivers using the so-called "inter-carrier" method of resolving the sound signal.

The dots, which indicate the active line synch. pulses have been retained for clarity, though they would not appear in official Standards information.

(Continued on Page 115)

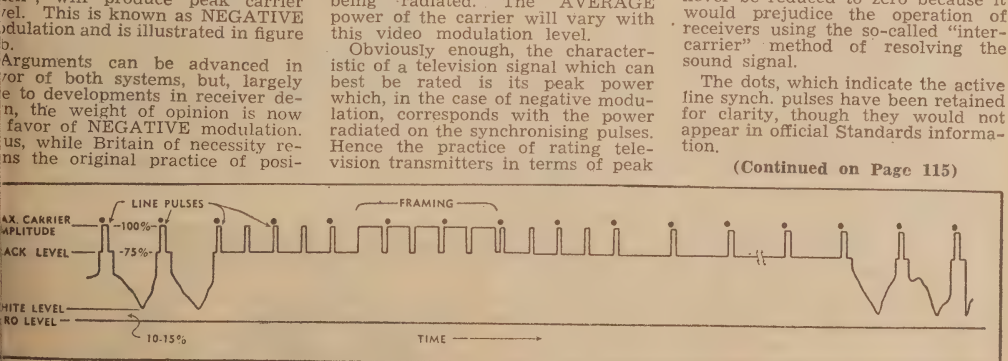

Figure 41: The video signal, originally depicted in figure 37, last month, is here shown superimposed on to a carrier. Note the relationship between peak carrier amplitude, black level and white level. Actual Standards Illustrations contain a great deal more information than this and incidentally show graphically the different sequence of pulses between odd and even frames.

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TRADE REVIEWS AND RELEASES

)UALITY CATHODE RAY TUBE FOR SMALL INSTRUMENTS

Although there are a large number of excellent cathode ray tubes available at small cost from disposals dealers, the majority are large and test equipment using them is necessarily bulky. Designers of small oscilloscopes will welcome the Cossor 23D, now available in this country.

The small dimensions of the 23D allow for compact designs.

'HE 23D is equivalent to the VCR139A, a war surplus item signed expressly for precision dar "A" scan so that alignment the deflector plates and electron n assembly can be expected to be tter than average.

The max. diameter is 2¾in and overall length 8in. The second ode voltage is usually 800V, but od definition and brilliance can obtained with a supply less than s where an economical design is quired.

The filament is rated at 4.0V and 1.1 A and the deflection sensitivity of both X and Y plates 170/V mm per volt where V is the second anode voltage.

The 23D is available ex stock from Jacoby, Mitchell and Co. Pty. Ltd., 481 Kent Street, Sydney, the price being £6/5/- plus sales tax.

INEXPENSIVE TV TEST GENERATOR

ROSPECTIVE television service engineers in this country will d the Teletest Model FS-4-A se generator of interest. The inument was designed expressly for stralian television standards.

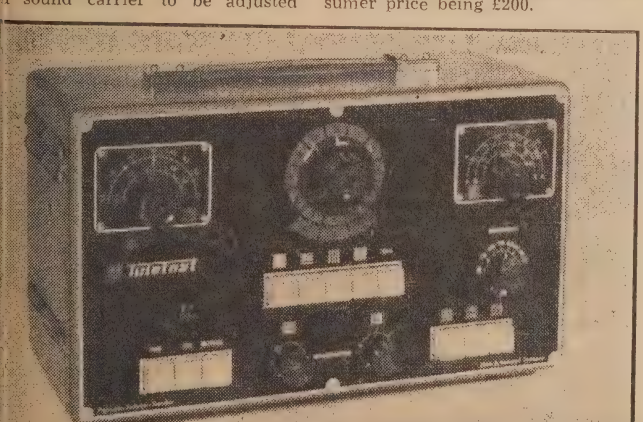
We have not as yet had the oppority of testing the FS-4-A in our n laboratory, but the manufacer's figures suggest that it will vide most of the signals required, h sufficient accuracy for the job keeping the customer's receiver rking to full efficiency.

Both picture and sound carriers provided on 10 channels between Mc and 210 Mc approx., the uracy of the picture carrier freency being better than 0.06 pc. calibrated dial enables the differce between the picture carrier d sound carrier to be adjusted from 5.2 Mc to 5.8 Mc. An internal audio generator frequency modulates the sound carrier at 800 cps and with a deviation of 30 Kc.

The picture/sound carrier is also available between 16 Mc and 45 Mc for intermediate frequency checks. Sound channel output between 10.4 Mc and 11.6 Mc is also provided.

Patterns consisting of vertical bars, horizontal bars and crossed bars are generated by a system of multivibrators and mixers and allow for speedy detection of nonliniarity of either line or frame generators in the receiver. Synchronising and blanking pulses are provided and the scanning line frequency is held constant within 0.1 pc.

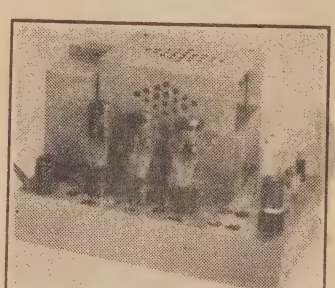
The instrument is available from Jacoby, Mitchell and Co. Pty. Ltd. and associated companies, the consumer price being £200.



ised on a German design, the FS-4-A generator offers extensive facilities at low cost. Maximum width is 15¾in.

AMPLIFIER HAS NO OUTPUT XFORMER

WITH conventional amplifiers the major factor limiting the amount of negative feedback is the output transformer. Phase shift is introduced at low frequencies due to the limited primary inductance of the transformer and at high frequencies due to leakage inductance and interwinding capacitance. This can cause oscillation at the extremes of the range.



The M.B.H. 30 watt amplifier.

Using output transformers of reasonable cost, the greatest amount of feedback which can be applied with stability is about 30 db. In many cases much less than this is desirable.

The MBH amplifier uses three 6AS7's in a special push-pull parallel circuit working directly into a 15 ohm voice coil circuit. Feedback amounting to 40 db is applied with stability resulting in an extremely low dynamic output impedance.

The makers guarantee the frequency response flat within 1 db between 10 cps and 150 Kc and the intermodulation distortion less than ½ pc at 30 watts.

The basic amplifier requires 1.0 V for full output but suitable preamplifier-control units are stock items.

The amplifier is available from High Fidelity Products and trade distributors, the retail price being £136/16/-.

OFF THE RECORD — NEWS & REVIEWS

Organ records do not appear very frequently in the monthly lists and it is therefore all the more important that, when they do, the results should be first class. Although they sound best only on big equipments able to accommodate the full frequency and dynamic ranges, well cut organ discs can be successful under more modest conditions.

by John Moyle

THE album reviewed here is of this type and has obviously been produced with considerable care.

BACH — Allabreve in D major, Toccata and Fugue in D minor, Prelude and Fugue in D major, E major and A minor (A00223L); Canzona in D minor, Fantasia in G major, Prelude and Fugue in G Minor, E minor, A minor and C minor. (A00224L). Played by Anton Heiller, organist. Two records in fully annotated album. Philips.

This is the second volume Philips have issued of Bach works played by Heiller.

The two records come in an extremely fine album with spiral binding which allows it to be opened out so that you can follow the copious annotations without damaging the album or its contents.

These include a full description of each work played together with a note of the registrations used.

There is also a complete analysis of the two organs which Heiller used for the discs. These are the organ of the Reformation Church of Thalwil and the organ of the Reformation Church of Wald, both built by Th. Kuhn, A.G., of Mannedorf, the first in 1946 and the second in 1949.

It is not clear which is used at any one time, but in any case it is only to be expected that they would speak alike.

The combination of these modern organs, and a man who is still in his early thirties has produced a youthful and generally vigorous Bach, portrayed with a precision and sonority which Bach himself is unlikely to have heard.

But apart from these two points, Heiller shows no inclination to exploit his resources for their own sake. Technically he is admirable, he makes his way through the most involved counterpoint with beautiful clarity, and a dexterity which is often dazzling.

Nor does he succumb to the temptation to glamorise—his restrained and majestic performance of the famous D minor Toccata and Fugue is a good instance of this. If anything, he is often a little too unrelenting in his approach, but he produces some magnificent playing.

Technically the records are admirable. The difficult organ balance has been handled with a full-bodied tone without any overcut bass notes to annoy you with distortion and groove-hopping. First-class work — most highly commended.

BACH J. S.—Suite No. 1 in C major, Suite No. 3 in D major. Played by the Berlin Chamber Orchestra directed by Hans von Benda. Radiola-Telefunken LE6525.

This isn't a very successful record when compared with some of the fine Bach recordings which have been issued.

My first impression was that a very bad hall had been selected which, by adding an unfortunate, heavy type of reverberation, has created confusion where there should be clarity, muddiness where we would expect to find precision.

It has also added a body to the sound which certainly doesn't give the impression of a Chambe orchestra. It sounds more like th entire Berlin Philharmonic, of whic it might well be a part.

This muddiness and undue rein forcement, particularly of th strings, almost completely ove shadows the harpsichord which, all but a few places, isn't heard all.

If you are not a purist no dou these points won't unduly worry yo for otherwise the record is OK wi a nice surface. The third Suite yo will recognise from several mov ments, including the Air on G Strin which makes up the third.

But otherwise you are apt judge this as rather bloated Bach

KODALY — Peacock Variations. BARTOK—Suite from the Miraculous Mandarin. Played by the Chicago Symphony Orchestra, conducted by Antal Dorati. Mercury MG50038.

This gains the five-star award the most impressively brilliant pie of recording I have heard for long time.

It is in the tradition of the famo "Pictures" record made by Mercu a few years ago, and is little any inferior to it.

The record jacket says that t music issues a challenge to recordi engineers. Well, I think it is ma to order for them. Both sides a largely exercises in sheer exploit tion of instrumental sound, wi countless opportunities to build the tense excitement of vivid a close recording.

The result is spectacular in t extreme. I would not say that t frequency range is extended to t limit, but it is wide and what more it is clean.

Credit must be shared with th who cut the disc, for, despite high amplitude, sudden fortissim and severe transients, it is co mendably free from any noticeab type of distortion. Nevertheles the dynamic range has not be sacrificed—it is truly terrific.

GOOD SURFACE

The surface, too, is perhaps t best I have heard from Mercu and there is no trouble to play with the AES curve.

Mercury can only expect revie ers to be hard on records less p fect than this one, having once monstrated what their engineers do!

The Kodaly variations are ba on a little folk tune, Fly, Peac Fly, but despite the simplicity the subject its treatment throu sixteen stages was designed spe fically as a showpiece for the chestra.

The Mandarin Suite, by fello Hungarian Bela Bartok, is tak from the music written for an am ing ballet with a theme rather

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stark to be fully detailed in these pages. It is enough to say that Bartok's briliant genius is displayed not only by his use of a big orchestra with an assisting organ, but in the skill of the orchestration, not forgetting the marvellous fugue worked into the final section.

Both Dorati and the orchestra do their best work with music of this kind.

This disc is a "must" if you like quality recording and brilliant music and even if you don't you shouldn't miss it.

BEETHOVEN—Symphony No. 5 in C Minor Opus 67. Played by the Vienna Philharmonic Orchestra conducted by Wilhelm Furtwangler, HMV OALP1195.

BEETHOVEN—Symphony No. 5 in C Minor Opus 67; Egmont, Coriolan and Leonore No. 3 Overtures. Played by the Chicago Symphony Orchestra conducted by Antal Dorati. Mercury MG50017.

There is a great contrast between these two versions of the fifth, considered by many, including myself, to be the greatest of Beethoven's symphonies.

As heard on these records, the marvel is that two men could see it so differently.

Dorati presents a vigorous performance, in no way profound, with the clear intention of blocking the music into large-scale shapes by the use of strong dynamics and contrasts.

Furtwangler's view is enormously more analytical. He plays it phrase by phrase, fully living up to its reputation for elongation to an incredible extent.

The fact that the third movement is marked Allegro means nothing to him. Nor for that matter does he really observe the same marking for the final movement.

Quite obviously he is aiming at magnificence, at building an impressive musical edifice which will do justice to this music of the gods.

The music might well have sounded that way in a concert hall, but it comes very near to being ponderous on records.

On these grounds alone I would prefer hear Dorati, but it would be the lesser of near-evils. Neither to my mind is as good as Kleiber's effort for Decca.

FINE SOUND

Both build up some fine sound in different ways. The HMV recording sounds to be a little rough, but on the whole it is good average.

The Mercury I thought overweighted at the top end, and far from playing it as advised with the EQS setting, found it much better with EMI or NAB.

The orchestra doesn't show up to complete advantage under the forward recording treatment, which I thought did occasional odd things to the balance. On the other hand it displays brightness in the right places without undue scrambling as it often happens in the final movement.

The overtures on the second side of the Mercury deserve much the same comment as does the first side. Again there is little profundity, but good, vigorous straight-forward playing.

But if you want to hear these overtures as they can be played you should hear Scherchen on an early Westminster.

Neither surface is remarkably good. Both have some crackles, and Mercury has some tape hiss. But with NAB setting and average room volume it probably won't worry you much.

SCHUMANN—Cello Concerto in A minor Opus 129. Played by Pablo Casals and the Prades Festival Orchestra. Philips ABR4035.

This record, made at the Prades Festival in 1953, might well be titled "Casals Plays Again" for the old master of the cello will not travel from his home in that city, and musicians, therefore, have to come to him.

As an historical record, I think the disc is most interesting, but as an aspirant for competitive honors I do not think it would win.

Casals certainly displays that supernatural quality referred to on the jacket—it is something that comes to a man to whom expression through his instrument is easier even than the spoken word.

But there is very little of the passionate vitality which marked his electrical performances of earlier years.

Nor is the orchestra, apparently a scratch band with an un-named conductor, endowed with much strength or even with well balanced recording.

It is not, therefore, a disciplined performance, and despite the optimistic references on the program, discipline and much careful shaping is needed to hold this concerto together. It is a mixture of poetry and banality, with which I fear we often have to contend in Schumann.

Technically, it is excellent with a smooth surface, and good sound. But I suggest you hear it before deciding whether it is your meat.

BEETHOVEN—Sonata in F minor (Appassionata). BACH—Chromatic Fantasia and Fugue in D minor. BRAHMS — Intermezzo in E flat minor Opus 118 No. 2 played by Maleuznyski. Columbia 330CX1144.

The playing here is vigorous, clean, and responsive, but it seems to lack what it must have to cover such a field—style.

The Beethoven is adventurous, and at times poetic enough, but it lacks cohesion and the shape which must be there to co-ordinate the ideas of the pianist over the entire work, and not merely for parts of it.

The final result is rather superficial, and not to be compared with several other versions in which mental resources are apparent in addition to manual dexterity and power.

The Bach in some ways sounds the best of the three, but even there the impression is rather of a rhythmic exercise. The Brahms should have an inner glow, which is not transmitted via this performance.

I can't therefore rate it as more than a good average record. At the same time one should recognise that the pianist set himself quite a task in fittting such a selection to a single disc.

The piano recording takes some hard pounding without any distress and you need have no fears on this score. The surface, too, is quite good.

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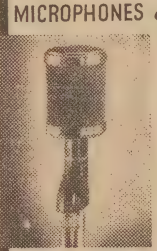

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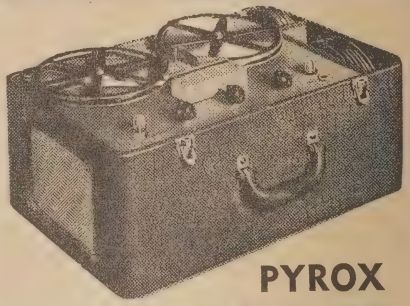

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Walter Gieseking, pianist. Columbia 330CX1137.

What a shame such a superb re-ord should be spoiled by a swishy irface on one side!

Maybe that's a blunt beginning, it I felt a bit blunt after listen-g to the near perfection of the verse side containing Pour le ano and Estampes.

The swish may not be character-tic of all copies, but unfortunate-it was there through the whole Images.

These pieces strike to the heart Debussy's piano music. Every anist plays them, and I'm sure ey all dream of the day when ey can handle Debussy like this. Gieseking, in my opinion, has long en unchallenged with Debussy, d this record shows why.

No need to worry about style with is man—every phrase shows his tural sensitivity to the color and nosphere of the music in the kind art that conceals art. These ngs are paramount. If you at-npt to pick all the notes that there you will be disappointed, t as you would be if you tried count the raindrops that make a shower, or the leaves that paint picture of autumn.

There is a slightly veiled quality out the piano tone which may be recording or it may be Giese-ig. At any rate it is not at out of character. At all times tone is clean.

In brief—if there is better De-ssy I'd like to hear it. Use the II setting. The surfaces are not rfect and as the frequency range 't high you can tone down your eeter.

CESAR FRANCK — Psyche, Symphonic Poem played by the Hague Philharmonic Orchestra, conducted by Willem van Otterloo. Philips A00262L.

This is a full recording, includ-the choral part, and takes two es. In this it differs from the y competitor I have to hand, a -up for a Bruckner symphony by Beinum and the Concertgebouw hestra, by Decca.

liked the Decca recording some-at better than the Philips, al-ught there isn't much to it. The ely con trolled contribution of the herlands choir would balance out superiority of the Concertge-w orchestra.

As it is, we have here a really utiful performance of a lovely k, notable mainly for its grace smoothness. Even the sufferings Psyche have been softened so that y do not break the swoonful ll of lovely sound.

n common with the rest of his ertoire, Cesar Franck manages to p this work alive in an altoge-ravishing manner with little iation in technique or material. ut then it is a dreamy, idyllic y of myth-and-legend love, ch is only to be supported by sic out of this world, and Franck few superiors in this depart-nt.

s the jacket notes reveal, it was tten about the time of the Sym-ny and its similarly lies not in the use of cyclic form, a prite device of Franck, but in ly snatches of melody and pro-ssion.

he first movement is probably omplete and beautiful an example of Franck's best work as there is to hear.

The EMI setting is about right, although the surface is smooth enough to stand AES with a noticeable brightening all round. It also tends to lift those woodwind passages more cleanly from the full-bodied orchestra. The commencement of the first movement is a good example of this, and later on it does the same thing for the 'cellos.

OPERA INTERMEZZI—from Cavalleria Rusticana, Pagliacci, Tales of Hoffman, Hary Janos, Manon Lescaut, Carmen, Thais, Khovantschina, Goyescas, La Traviata, an L'Amico Fritz. Played by the Philharmonia Orchestra, conducted by Herbert von Karajan. Columbia 330CX1265.

This is a first-rate disc. As the title reveals, it contains most of the well-known Intermezzi together with some others not so well known, all played in first-rate style by Karajan and his forces.

Every one is well done. A bit more sympathy could have been shown to the Barcarolle, but it is made up for by the beautiful playing of the Thais Meditation by Manoug Parikian, whom I don't know but who is probably a member of the Orchestra. The Traviata Prelude, too, is very good.

No need to say more than that the recording is first-rate also, and I would rate it as a most superior, popular classic record.

The EMI compensation is best. The surface isn't quite good enough to take the AES, nor for that matter is the range wide enough to warrant it.

FRANCK—Symphonic Variations. D'INDY—Symphony on a French Mountain Air. Played by the Orchestre de la Societe Des Concerts du Conservatoire conducted by Andre Cluytens, with Aldo Ciccolini, pianist. Columbia 330CX1190.

The Cesar Franck has an irritating effect on me—the piano is too far forward, and there is something about its sound which becomes oppressive, as if it were being played without much strength and with a close microphone to build up the tone. It makes the pianist sound fiddly.

The orchestra as a result isn't given much of a chance and has little reverberation to help it.

This impression isn't so noticeable on the other side, on which the piano is heard from just that amount of distance further back to allow it to blend in with the orchestra as it should.

The point is that the balance between the two shouldn't greatly differ from one side to the other.

In the symphony, the rather dead acoustics of the Theatre des Champs-Elysees don't give much impression of the French mountain air. I feel the music needs some of it to build up a mental picture anything like the superb view on the record jacket.

Mostly the orchestra is clean and competent, but there are a few not-so-good moments, particularly from the wind players.

The surface is very good, and the EMI setting is quite suitable. I liked the D'Indy the better of the two, but judge for yourself. I would be inclined to look for less meticulousness and more magic.

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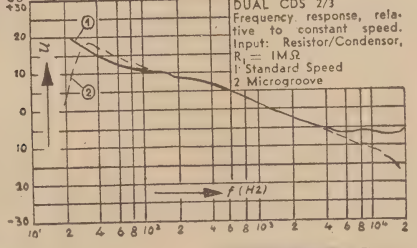

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DEBUSSY — Quartet in G Minor. Milhaud—Quartet No. 12. Played by the Quartetto Italiano. Columbia 330CX1155.

The only serious criticism I ha of this disc is that someone h picked a very heavy recordi chamber.

Compared with some of the fi bright string records, which ha been released, this one is as dull ditch-water.

You will get used to it after while, but it does take the bloo off what is otherwise an extreme high quality performance.

I am not familiar with the M haud quartet, but the Debussy—t only string quartet by the way admirably suits the style of t players who bring to it a high d gree of sensitivity and flexibility.

Their ensemble is good and tec nically they are very neat, even a violin does run out of bow one note.

Despite a tone, which is appro mately equal to a permanent ha mute, I found myself accepting so lovely sounds without serious stru gle.

The Milhaud is a most interesti work—not at all outlandish modern ears, and strangely like Debussy in mood.

It doesn't matter much what co pensation you use. The surface is quite good enough for AES, this setting does brighten sound, although I doubt whet there is much at the top end to boosted. I suggest EMI.

Another technical grouch—w cut the sound so quickly at the of at least three movements? extra couple of seconds would h made no difference except to av an unpleasantly sudden return the material world.

BRUCKNER—Symphony No 3 in D minor. Played by th Vienna Philharmonic Orchestr conducted by Hans Knapperts busch. Decca LXTA2967.

Those who like their sound and plenty of it won't have m trouble in extracting pleasure fr Bruckner, and this goes for symphony along with the others find it extremely attractive and times mighty impressive, altho inclined to sprawl into untidy sh

You won't find anything neat nice, classical way about this m

In a symphony built on an en mously portentous theme for br he spends half the last moveme usually the tour de force and ap priately tagged Allegro—in a li hearted polka played against chorale solemnly intoned by brass. Only after he has exhau these jinks does he gather his fo and do the right thing with an pressive close.

Whether you call it sprawl untidiness, shapelessness, or ge depends on many things, but the conductor and the orchestra convince you with no trouble a that they know what it's all ab

And they do it with a recor and a performance which is re big. The many huge climaxes handled with great firmness weight, both brass and strings b particularly impressive.

There is a good measure of verberation in the hall, whic thought went well with this life-size music.

The recording dates back a co of years, but Decca could avoided some groove echo on a loud passages, and for that m

ome swish which appears at the art of the second side.

Incidentally, this is called the Wagner" symphony because it was edicated to Wagner, who received with enthusiasm. It did include iginally some Wagnerian themes, nd still retains a few traces, alough these were nearly all removd in subsequent editings.

This is quite a disc. It plays well ith the Decca setting.

ANDRE SEGOVIA PLAYS—Fourteen selections and arrangements for the guitar by composers including Bach, Haydn, Grieg and Franck. Columbia 330SX7528.

We have had some steely, spine-ngling guitar records in recent ars, which have given us exciting usical moments, and often tickled r ears with vital sound.

Now hear the old master of them l, Andre Segovia, the man whose vely guitar interludes fascinated e as radio station fill-ins long be-re I knew who he was.

Even at the age of 63, he is able display all the technical and usical mastery that makes his play-g unforgettable.

His tone is full and warm and is ard from surfaces which are ooth and quiet. The microphone sufficiently remote to escape most the digital noises which some-es spoil guitar records, and pos-ly Segovia is particularly adroit avoiding them.

But it is close enough to show his autifully controlled technique and e production and skilful use of namics.

The little Haydn Minuet is as od an example of all these things anything on the records.

Don't buy this disc for show pur-es. Buy it to play, many times, d to enjoy for a rare example of usual and front-rank artistry.

RACHMANINOFF — The Isle of the Dead. DUKAS—La Peri. Played by l'Orchestre de la Societe des Concerts du Conservatoire de Paris, conducted by Ernest Ansermet. Decca LXT5003.

This a well-balanced record in sense that the music, orchestra d conductor are well chosen.

Both works are symphonic pic-es—one a grave, mysterious pic-e of a journey to the dead island portrayed in a famous painting the day, and the other a story-llet about a fairy who lost the wer of Immortality and had to ace to regain it.

As such, they offer great contrasts. chmaninoff here has little in com-n with the composer of the ous piano concertos and sym-nies—they have little to do with my death. Dukas, in his musi-tale, paints his picture on a e and brilliant page which ches death only in the final bars, n the stealer of the Flower, hav-been forced to surrender it, rea-s that his lost youth cannot be ained, and that his end draws r.

hese are cold words to describe sensitive and lovely perform-es given here by Ansermet. The rding is one of those finely-wn Deccas in which the delicate e colors of such music are so portrayed.

f its type, a distinguished re-e. Decca compensation is OK the surface good.

SIBELIUS—Violin Concerto in D minor Opus 47. Played by David Oistrakh and the Stockholm Festival Orchestra conducted by Sixten Ehrling. Columbia 330C1036.

This must be set down as the best recording of the Sibelius issued to date.

Its only rival is that by Jan Damen for Decca, and issued a few months ago.

Damen impressed me as a man with a fine conception of what he was doing, but with an uncertainty of technique which too often betrayed him.

But, particularly, in the first two movements, he shows passionate musicianship and a fine understanding of the concerto. If it were not for a rather scratchy final movement in which intonation suffers, that record would be hard to beat.

Oistrakh's superb workmanship and tone weigh very heavily in his favor, although to me his very perfection is a barrier to achieving the same vital intensity which was Damen's chief asset.

In the final movement, Oistrakh makes Damen's performance almost embarrassingly inadequate, for it is here that the comparison between their techniques is most marked.

Damen's orchestra I thought much better than the Stockholm group, not only in its actual recording, but in its feeling for the music.

It has a much more expansive air, and it sounds altogether more expanded and immediate.

To state the impossible—if we could blend this orchestra with an Oistrakh miraculously endowed with Damen's freedom from inhibition we would have a recording to end them all!

The Stockholm players seem to be battling with a small recording chamber, although this effect does not show up as noticeably as in the recently released Beethoven concerto. The Sibelius technically is a much better balanced job than was that record.

The surface is good, and the fact that it is only a 10-incher makes it an automatic choice.

ELGAR—Enigma Variations, Cockaigne Overture, Serenade for Strings. Played by the Royal Philharmonic Orchestra, conducted by Sir Thomas Beecham. Philips A0118OL.

Noting the name of Beecham as the conductor of this record, I could not but remember Neville Cardus' story of Beecham's alleged disdain of Elgar. Cardus says that Beecham rang him up once, late at night, to indulge in one of his long monologues about music. The subject this time was British composers, and Cardus waited in vain while Beecham ran through the list. Finally, unable to stand it any longer, Cardus said, "What about Elgar?" "What about him?" replied Beecham, "Isn't he well?"

It's a lovely story, anyhow, even if its implications are unsupported by the disc under review.

For Beecham I think handles the Enigma as though he had loved it all his life. To me it was a progressive delight to note how truly the atmosphere of each had been caught.

The recording is really a splendid one. It is full and resonant, well-balanced internally, and with a most impressive and weighty bass.

This is heard to great advantage in many places, not the least so in No. 13, about the lady on a sea voyage, in which the drums beat out the rhythm of the engines, and, of course, in the flourishing finale.

The high frequency end, too, is clean, with no edge or shrillness.

The second side is taken up with an exhilarating performance of the pretentious Cockaigne overture, a tone-poem of London in Elgar's time, and the lovely Serenade for Strings, so characteristic of Elgar's quiet moods.

This is a very good disc, and the

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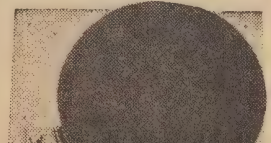

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logical buy now for a performance of the Enigma. The surface is very quiet, and technically I have no bones to pick with it.

It will take the AES setting, but I thought it sounded best with EMI. Probably RIAA would be best of all.

Incidentally, the cover contains pictures of all the people represented by the various Variations. The Enigma is an Enigma no longer.

OFFENBACH—Tales of Hoffman. Raoul Jobin as Hoffman with the Orchestra and Chorus of the Theatre National de L'Opera-Comique conducted by Andre Cluytens. Columbia 33CX1150-2.

There are few operas more rewarding than the Tales of Hoffman.

First of all it is always musical. There are no long, boring episodes. It is all easy to follow, particularly with Columbia's fine little book of words, and there are smash hits galore.

Hoffman has everyone's sympathy. We know in advance that his love affairs will all turn out unhappily, that he will be spurned, deceived, and made to look ridiculous, but that he will bear it all, and endure it all, for the sake of love.

Maybe many of us have a fellow feeling, however remote, with many of his happy and unhappy reactions!

It is all done with a mixture of sentiment and gusty fatalism that keeps it always on the earth, despite the fantastic air of some events.

NOT NEW

This isn't a new recording—it was taken from a set of 78's and at times we can pick the changes.

One such seems to be at the end of a very perfunctory Barcarolle which follows Act III. I wonder if the rush were due to the need to make the end of a side in time? The sudden chopping of sound suggests it.

But, on the whole, the editing which has gone on is extremely good, and a surprising quality and silent background has been reached.

This recording is all Hoffman—he is head and shoulders over the rest of the cast, certainly in dramatic effects and mostly in voice. He is a youthful and impetuous Hoffman—not just a love-sick youth, but an extremely unhappy man who convinces us that, when the climax to his impetuosity and almost childish faith in the truth of true love has broken his heart, delirium and final alcoholic blackout are an inevitable and proper end.

Not that the other voices are at all bad. On the contrary, the only one I really disliked was the soprano in the third act who dies because she disobeyed her instructions to sing no more. With all respect, a fitting end, I thought. It is in this act, too, and with this singer, that most of the rare distorted sections are to be heard.

The general tone hasn't the freedom and roundness of today's efforts, but its vitality, its charm, and its Hoffman hold it together.

And there I think it will stay until a better version arrives.

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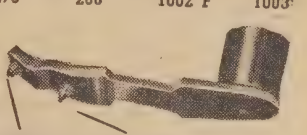

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TAIWAN USES NEW FREQUENCIES

New frequencies have been added by many of the Taiwan stations which give fair reception in this area.

THE Broadcasting Corporation of China, which is Government operated and carries the Voice of Free China transmissions from Taipeh, the Taiwan capital, has new calls assigned to several stations; so reports our correspondent in that area, Mr. C. S. Feng, Okinawa.

Broadcasting Corporation stations are BED22 (660) in parallel with BED29 (3220) and 5980 Kc, operating 8 am-noon, 12.22-5 pm, 7.30 pm-2 am. BED2 (750). Voice of Free China also broadcasts in Chinese to the Mainland on BED33 (4770), BED34 (5010), BED35 (7198), BED36 (8525), BED37 (11,800), BED38 (15,105), operating 7.55-11 am, 1.55-4 pm, 7.50 pm-3 am.

PRIVATE STATIONS

Military Broadcasting Station BEC22 (1100) is relayed on 5950 and 11,745 Kc at Taipeh. BEC23 (1200) is relayed on 7140 Kc. It uses 1500 watts and verifies with a card from Military Broadcasting Station, Shih-Fu Rd., Taichung.

BEC24 (1250 and 9510), Kaoshung, BEC26 (1330, 11,755), Tsoying, all operate 8.30-10.30 am, 1.50-4.30 pm, 7.35 pm-1.30 am. BEC22, BEC26, BEC24 and all sign off at 2 am.

The Voice of Righteousness, operated by the Cheng Sheng Broadcasting Corporation Ltd., 140-6 Chang An West Rd., Taipeh, has confirmed our reception with a letter and photos. The station broadcasts English 9.30-10 am and 1-1.30 pm.

The station operates BEC36 on 7300 and 5995 Kc, 8-9 am, and, as well as the afternoon transmission, can be heard from 7 pm to sign off 3.5 am. English hymn sessions have been heard on BEC36 at 9 pm.

Air Force Broadcasting Station BEC32 (980 9775 6106), at Taipeh, is broadcasting 8.30-10 am, 1.55-4 pm, 7 pm-2 am. Police Broadcast Station BEC38 uses 940 and 5960 Kc, 8.30-11.10 am, 1.55-5 pm and 7.30 pm to 2 am, these latter stations being located in Taipeh.

New Brazilian Stations

USING the frequencies of 11,775 and 9575 Kc, a new voice from Rio De Janeiro is being well received in New Zealand. Using 50 Kw on both frequencies, the best signals are on 11,775 when at noon transmissions are first received, strength improving to 1 pm, at which time Radio New Zealand commencing transmission on 11,780 Kc, causes interference. The Brazilians generally sign off at 1.40 pm. The stations relay the medium wave transmitter PRA9, and the mailing address is Radio Mayrink Veiga, Rue Mayrink Veiga 15, Rio de Janeiro.

British North Borneo

REPORTED last issue as adding a new evening schedule, this transmission of Radio Sabah at Jesselton, has been logged on 7237 Kc. BBC news is broadcast at 9 pm, when the station can be heard through the very severe side interference. At 9.50 pm this becomes more severe with the opening of All India Radio on 7240 Kc. The schedule is 7.30-10 pm from new studios at Jesselton and though scheduled to increase to 5000 watts, signals would indicate that they are still on 250 watts. The broadcasts are made up of sessions in Chinese, 7.30-8.15 pm; Malay, 8.15-9 pm, and English, 9-10 pm.

Commercial Broadcasts For Sweden

SWEDEN, one of Europe's most radio-minded countries, is to have a commercial transmission on shortwave. The Government operated Swedish Broadcasting Corporation has no commercial transmissions, but a company has been formed in Sweden and a transmitter built at the International Zone of Tangiers. Though located some distance from Sweden, the transmission should provide entertaining signals if a clear channel can be found, and tests are being made to this end at present.

Notes should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Eastern Australian.

Transmissions at present are being carried on 15.400 Kc at 6 am and the musical number "Swedish Rhapsody" is used as identification signal.

Commercial broadcasts from another country are not uncommon these days and the activities of Radio Luxemburg, with broadcasts to United Kingdom, are the best known. Monte Carlo has French commercial programs, Andorra is beamed to Spain, Radio Ceylon and Radio Goa to India, Lourenco Marques to South Africa and there are many others on the shortwave bands.

Reports on the reception of the test broadcasts of the new Tangier station would be sent to the well-known DX Editor of the session on Radio Sweden, Mr. Arne Skoog, Rindvagen 14, Danderyn, Stockholm, Sweden.

CHINESE STATIONS WHICH YOU MAY HEAR

KCS	CALL	LOCATION and OWNERS.
3220	BED29	Taipeh, BCC
4770	BED33	Taipeh, BCC.
5010	BED34	Taipeh, BCC.
5950	BEC22	Taipeh, Military.
5960	BEC38	Taipeh, Police.
5980	BED29	Taipeh, BCC.
5995	BEC36	Taipeh, Voice of Righteousness.
6095	BED29	Taipeh, BCC.
6106	BEC32	Taipeh, Air Force.
7140	BEC23	Taichung, Military.
7150	BED7	Taipeh, BCC.
7198	BEC35	Taipeh, BCC.
7300	BEC36	Taipeh, Voice of Righteousness.
9510	BEC24	Koashung, Military.
9525	BED36	Taipeh, BCC.
9775	BEC32	Taipeh, Air Force.
11736	BED6	Taipeh, BCC.
11745	BEC22	Taipeh Military.
11755	BEC26	Tsoying, Military.
11800	BED37	Taipeh, BCC.
11920	BED4	Taipeh, BCC.
15105	BED38	Taipeh, BCC.

FLASHES FROM EVERYWHERE

BRITISH SOLOMON station VQ using 5960 Kc, has verified Dick P lard, Golden Downs, NZ, with the formation that the station operates o Monday to Saturday on the earlier ported schedule of 5-6 pm. The ve fication letter was issued by the P and Telegraph Department at Honia British Solomon Islands.

FRENCH CAMEROONS is at pres the scene of increased radio broadca ing activity and this country should s be within the listening possibility of t area.

The World Radio Handbook Bulle reports the latest schedule on R Douala on 2459 Kc and 6115 Kc, b 1000 watts, as, week days 9.15-10.30 Sunday 1-6 am, Monday from 3 to 6 Other days 3-6 am. News in French broadcast 9.20 pm and 4.30 am dail

Programs in Ewonda, Tuesday, Thu day, Saturday, 9.30-10.30 pm, in Dou Monday, Wednesday, Saturday, 9.30-1 pm.

Radio Yaounde on 9270 Kc, 1KW, bro casts Saturday, 3-6 am.

Sunday 3-7 am, Sunday 6-10.30 and 3-6.15 am on Monday.

These broadcasts are experimental from February 1 will then be d Programs in Ewonda 3-4 am, other grams in French, with news at 4.30 As from July 1, 1956 the station also be broadcasting over 3366 Kc a power of 4 Kw.

MONACO'S Radio: Monte Carlo been noted on a new 41-metre qu the new frequency being 7140 Kc, station, using the call-sign 3AM4, formerly on 7348 Kc. The new freque is relatively free from interference 4 pm when opening and the same gram is also transmited on 6035 Kc. ports from Europe list the new frequ as high as 7170 Kc, but our listening finds them on 7140 Kc so it app that the frequency could be variable

MOSCOW'S transmission to South Asia from 9 to 9.30 pm is very well ceived in the 16 and 19-metre b Recently European listeners have receiving a small recording with verifications of the USSR National them.

INDIA'S new 25 Kw relay statio Simla, which carries North Regional grams from Delhi, and now ope noon-1 pm on 476 Kc, 10 pm-1.45 (to 3.30 am Sundays) on 3223 Kc.

Radio Sao Paulo

NOT to be confused with Radiodif Sao Paulo, ZYB7 (6095), ZYB8 (11 a new station has been heard on Kc, using the slogan "Radio Sao P Signals in New Zealand are only on this station to sign off at 1 pm. reception seems to be enjoyed by pean listeners and from the De Welle Cologne DX session, we not call-sign as PRB24 on 11,965 Kc, rel the BC station PRA5 on 1260 Kc. Sao Paulo stations broadcast pro in Japanese, recorded in Japan, these are carried on PRB21 (6055) pm, PRB23 (15.135), 8-9 pm, (6095), 8-9 pm. These programs a corded at Radio Kyushu, Fukuoka, J

THE HAM BANDS WITH BILL MOORE

AMATEUR HOLDS POSITION IN NEW FEDERAL CABINET

Radio Amateurs throughout Australia were extremely pleased to learn of the elevation of Mr. Allan Fairhall MP to the position of Interior and Works, announced by the Prime Minister on Jan. 10.

VK2KB, the call sign of the new inister, has been known on the air for arly 30 years. Commencing with radio a hobby, he opened Broadcasting Sta- n 2KO Newcastle, in the early '30's. retired from active participation in e radio industry on entering the House Representatives as the member for tterson in 1949.

The new Postmaster-General, who succeeds Mr. An hony in the post, is Mr. harles Davidson, the member for Daw- n, Queensland. A veteran from two orld wars, he still holds the rank of eut.-Colonel in the army and is well nown for his leadership in the New uinea campaign.

MERGENCY NETS

n most countries throughout the world nateur radio societies have fully or- nised nets for emergency working dur- g flood and national disaster.

To ensure they are always ready for eration, tests are conducted regularly der conditions likely to be experienced ring such working.

In both Great Britain and the US, nateur radio national societies have ently conducted simulated emergency erations for their net organisations.

The UK event was in the form of a lly, a large number of stations oper- ed in the field and from home loca- ns. The RAEN (Radio Amateur Emer- ncy Net) test was conducted on tele- ony, using standard messages drawn for the event. The final summary results has not been published to date.

A number of suggestions have, how- er been submitted to the RSGB, in- living a limiting of operating periods d restriction of operation to the 3.5 Mc nd.

Individual groups throughout the UK ve been also conducting emergency ercises with mobile, portable and fixed ations co-operating.

The US event was conducted on a der scale where the various amateur ergency nets are officially recognised civilian, governmental and service thorities.

It is an annual event conducted by e ARRL and the general arrangement as follows:—

The Emergency Co-ordinator in any ea calls a surprise alert at any time er the weekend. The test can be nted toward a national disaster or an emy attack. In the first case Red oss participation is arranged, and in e second the local Civil Defence auth- ities are contacted.

ROCEDURE

Each local participant transmits a ssage to the EC announcing his in- tion of co-operating in the net opera- n.

The EC then despatches a message to e ARRL HQ describing the test and ting the stations participating.

The local Red Cross chairman or Civil fence director originates a message to eir HQ announcing the conducting of e emergency operation.

A maximum of publicity for the test obtained in the local Press and repre- ntatives are invited to witness the exer- e.

A full report is forwarded to the RRL. Offcial station WIAW is active ring the whole weekend to receive oorts of operation.

During the two days, thousands of W stations are active in the exercise with mobile portable and home station equipment to demonstrate to the public and the various authorities the value of the hobby in emergencies.

Just a month previously during the disaster that was termed the Great Flood of 1955, radio amateurs performed tremendous communication feats in the north-east section of the US. Many operators worked continuously for a week during the floods.

Some individual efforts were in the finest traditions of the hobby. One amateur saw his home washed away and his mother drowned but battled to the local Civil Defence Headquarters to communications.

It is now proposed that the Amateur Radio Service in the US will shortly be under the direction of a radio security service called "Conelrad" (Control of Electromagnetic Radiation) during national war emergencies. Its purpose is to shutdown all amateur radio stations except RACES (Radio Amateur Civil Emergency Service) stations in the event of an enemy attack or threat thereof. Other radio services are already under Conelrad control.

The objective is to minimise the navigational aid that may be obtained from the signals emanating from amateur stations.

MONITOR EQUIPMENT

Station licencees will be required to provide a means of receiving the Conelrad radio alert which would be broadcast by BC and TV stations before they themselves close down.

Monitoring of 640 and 1240 Kcs would be necessary during an alert to learn of its cancellation. The fact that an alert is in progress can be ascertained by the BC stations operating and observations should be made at the commencement of each transmission and every 10 minutes thereafter.

Amateur stations must immediately close on the receipt of an alert.

RACES stations may operate but on a restricted basis and only in cases of extreme emergency. Transmissions must be short, station identification should not be used, nor should the location be announced. The regulation will mean that amateurs will have to provide some means of monitoring the local BC or TV station either aurally or by some visual means.

REGULATIONS

In comparison with amateur radio regulations in overseas countries, here in Australia we generally enjoy greater operating privileges with possible exception of the USA.

Recently in Great Britain the authorities relaxed a regulation that had operated for many years covering a CW probationary period. Prior to this change new amateurs had to confine their activities to Morse working during the first year. They need no longer submit their log books to the GPO for inspection of the first year's operation.

There is to be no variation of the code requirement which remains at 12 W.P.M. This action was taken as a result of representations to the authorities by the Radio Society of Great Britain.

The Region 1 Executive Committee of the International Amateur Radio Union met in Amsterdam late last year. Representatives from Sweden Holland, Switzerland, and the UK attended to prepare an agenda for the IARU R tion's conference to be held in Italy during June.

Active representation at the CCIR and ITU conferences, emergency net operation in Europe, band planning and general technical developments affecting amateur radio, will be discussed at length at the Italian conference.

It has been decided that no International Telecommunications Union Radio conference will be held this year. The decision was reached after consideration of the fact that many of the frequency allocations in the spectrum made at Atlantic City had not been fully implemented. The position will be reviewed later in 1956.

The "Prestige station" as it is termed by the RSGB is set up at the Science Museum, Kensington, London. It is anticipated that the station will not only make its mark in world-wide communication but will also provide a regular marker signal service in the VHF/UHF spectrum. This service should be of considerable value to workers in this field.

The whole station when completely installed will be a model of its kind. Officials of the museum and representatives of the RSGB are certain that the exhibit will be of value and increase the prestige of the hobby.

"HAM" RADIO IS DEMOCRATIC HOBBY

A statement that has been published from time to time in QST is perhaps the most descriptive ever printed covering the hobby.

It was written over 20 years ago by Dr. Raymond V. Bower, of Yale University, a sociologist who picked on amateur radio as a subject during social studies. The text is well worth repeating.

"The central trait is the means of communication with others on equal terms of finding friendship, adventure and prestige while seated at one's own fireside.

"In picking his human contacts out of the air the amateur is not seen by them. He is not known by the company he keeps nor by the clothes he wears, but by the signals he emits. He enters a new world whose qualifications for success are within his reach. A good home-made set gives him more prestige than a commercially-manufactured one. There are no century-old class prejudices to impede his progress. He enters a thoroughly democratic world where he rises or falls by his own efforts.

"When he is W9XYZ, a beginner, the radio elders help him willingly and when he becomes W9XYZ, the record-breaker and efficient traffic handler, he willingly helps the younger generation. Without a pedigree, a chauffeur or an old master decorating his living-room, he can become a prince—of the air. At the close of the day, filled with the monotonous routine of the machine age, he can find adventure, vicarious travel, prestige and friendship by throwing a switch and pounding his signals into the air."

Although written so long ago, it is still a true picture of our hobby and its variations.

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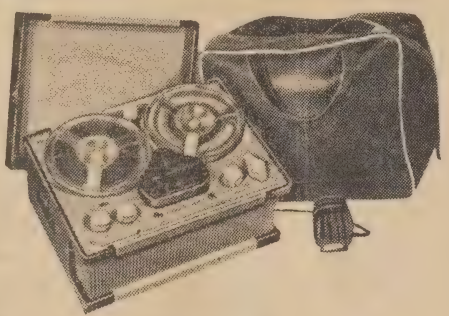

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WIA RAISING FUNDS

THE NSW Division of the WIA is currently raising funds by subscription for the establishment of a VK2WI station at Dural, some 16 miles north of Sydney. The council considers that VK2WI should be established in a location where full use can be made of the 500 watts maximum power permitted for official WIA broadcasts.

An effective transmission on 80 metres, together with the 40-metre signal, would ensure effective coverage of the State even under the worst propagation conditions.

The site of some acres has been selected and field strength tests carried out. It is a proclaimed rural area and BCI problems should be at a minimum.

The NSW Amateur Radio Co-operative Ltd. is also progressing with their plans to obtain a hall and office space to be used by the NSW Division. The next six months should see considerable change for VK2WI and WIA arrangements in NSW.

VISIT TO PHILIPPINES

LORRIE MEYERS VK2VN, recently returned from the Philippines, had the opportunity of meeting a number of DU amateurs when attending the International Civil Aviation Pacific Region conference.

At one function, jointly organised by the Institute of Electronics and Communication (the professional body), and the Philippines Amateur Radio Association, many well-known DU amateurs were present and Morrie was able to obtain an excellent insight into conditions over there.

At the combined function the following amateurs were present: DU1MC, Vice-president of the P.A.R.A., DU1RT SSL manager, ITN, IVP IEC, ICE, IMB, MC, IEF.

Operation by radio amateurs in the Philippines is still restricted to a degree. Originally, some years after the war, they were granted permission to operate but could only contact other DU amateurs. A few years later they were allowed to communicate with W stations as well. Currently they are permitted to make formal exchanges, reports, times, &c., with any station in the world.

They hope that shortly the authorities will relax the present regulations and are working to this end.

If your contact with a DU station is at short you will know the reason.

Good equipment is very scarce and quite costly. It is all of American origin.

The association operates on similar lines to other national bodies. At the moment they are working on a Civil Defence communications organisation, the reorganisation of their HQ station and endeavoring to obtain permission for third-party traffic to be handled to USA.

Code practice is transmitted from the DU station and suitable technical instruction is given to intending amateurs.

Many well-known officials operate amateur stations DU1EM is Deputy Administrator of Civil Aviation.

The Philippine amateurs extend their best wishes to their VK friends.

CONTEST NOTES

PROPAGATION conditions during the first month of the 1955/56 WIA Ross Hull Memorial Contest were extremely poor and did not encourage competitors.

Sporadic E openings were few and the anticipated 50 Mc DX season did not eventuate.

From NSW a few poor openings appeared to New Zealand and to other states but nothing to compare with previous years. Some amateurs in outlying areas have only recorded one opening.

Scores noted to date are low and it is hoped that January will bring improved conditions.

John Miller, VK2ANF, observes, from previous experience, that the sporadic E maximum occurs some two years after the sun-spot maxima. The last sun-spot peak was in 1946-47, while 50 Mc DX conditions were not at their best until 1949-50.

It may be some years before good 50 Mc DX signals appear regularly.

NOTES FROM VK6

THE first transmitter hunt on 144 Mc conducted by the WA VHF group created a great deal of interest. Eight cars participated. The transmitter, which was hidden in Maida Vale and was found five minutes before time by Ralph, VK6ZAD, and his team, VK6ZAE, VK6ZAT and VK6ZAK. Ralph was the only one to find the transmitter in the time allowed. He used a four-element array mounted on dural tube which was slipped over the car whip antenna.

The receiver was a crystal-controlled converter working into the car BC receiver.

After the hunt about 40 persons attended the Christmas party of the group, held at Syd, VK6SJ's, home. A post-mortem of the hunt was held and everyone was very enthusiastic about conducting another one shortly. Ralph, as a reward for winning the search, is to hide the transmitter in the next hunt.

50 Mcs opened later this year than in previous years.

The first contact from Perth was between VK6HK and ZL2ADA on December 11. The band then opened to VK5 and VK7. Openings since that date have occurred to all States except Northern Territory and VK9. VK6ZAV, 6ZAZ and 6ZAA are all monitoring 50 Mcs for openings and then checking 144 Mcs for DX conditions. Interstate schedules have been run with VK5RO and VK5QR without success.

Congratulations to junior member Kevin Bicknell for his creditable efforts in the receiving section of the Remembrance Day Contest.

In the television field Warren, VK6WJ, has almost completed his TV camera tube equipment, after some difficulty with deflection coils. He is now obtaining quite good pictures of people, &c., and estimates that he has a 3 Mc resolution on the test pattern. His main interest at the moment is what frequencies will be allocated for amateur TV. With Eric VK6EC, and Warren active, Perth could have amateur TV before 1957. Let us hope so!

144MC RESEARCH

FOR over two years now US amateurs have been conducting experiments transmitting 144 Mc signals over long paths by means of reflections from meteor paths. Tape recordings of the work have been circulated throughout the country and have attracted favorable comment from scientific bodies.

W4HHK is the leading exponent of the art and has recorded contacts by the above means with W1FZJ at a distance of 1100 miles and with W7VMP at 1300 miles.

He has now contacted on 144 Mc 28 of the 48 States and nine out of the 10 call areas in America.

Of course, most of these stations were contacted by normal mehods but the two additional States worked with aid of meteor scatter make him the leading amateur in listed contacts.

The normal period for transmission now adopted is one minute each way. Schedules are usually arranged in the mornings with stations transmitting alternately.

To some degree it is a hit and miss method and sometimes an hour is spent exchanging call-signs and signal reports.

Most tests are made when meteor showers are known to be present and fairly high speed Morse is generally used as reflections are for brief periods only in most cases.

It takes plenty of power and many elements (generally about 64 are used) to ensure success. To date no similar experiments have been carried out on the 50 Mc band, but it is anticipated they will commence shortly.

DX NOTES

THE leading tally for the ARRL's DXCC in the CW section has now reached 260 countries, amassed by Chas. Mellon, W1FH. His nearest rival is Don Wallace, W6AM six countries behind, with a total of 254. American stations with their KW now fill 12 of the 13 leading places with Jamie, PY2CK, the only intruder. The latter leads the telephony section with 243 countries, confirmed with W1FH, with 233 confirmations.

It is rather difficult to obtain an accurate total of the world's countries with national movements, &c., changing country status quite often. Official country lists show a total of some 275 countries currently, so W1FH has not a great deal of scope for furher activity. These leading DX men spend a tremendous amount of time planning listening and finally operating in their quest for a new country.

During December the best DX peak appeared on 14 Mc around 0130 to 0200 hours when European and African signals were really at excellent strength. It is rather late but some of the hardier DX typers were making good progress with the rarer prefixes. VQ6LQ and FB8ZZ were running up to S8 at times.

AC5PN, Bhutan, was the centre of attraction during the month. Extensive organisation was noted in endeavors to make contact. A number of the DX gang are complaining bitterly of the thrashing the AC was taking on his frequency.

They all appreciate that the control of a rare station's frequency is largely in his own hands when he directs other stations to answer 10 Kcs away, but they do think that if he does not exercise his powers the DX fraternity at least should keep a few Kcs either side. The dog-pile forming on AC5PN was terrific with the net result that dozens of stations were wasting their time in calling and then listening to a mass of squealing signals. Some stations are consistent offenders; they should consider other stations operating.

The essence of good DX working is solid copy of the rare one and then everyone knows when to start calling for his next contact. Far too much effort is necessary to contact a new country, especially if it is a rare one. Observing a few simple rules would make it easier for all concerned.

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3D6	10/-	828	£2/10/-
6AG5	9/6	843	£1/10/-
6AM5	15/-	957	6/6
6AM6	17/6	1619	£1
6H6	7/6	1625	£1
6J6	15/-	1629	10/-
6J7G	9/6	2050	£1
6N7	10/-	4307A	10/-
6SK7	12/6	9001	8/6
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24V	250V 60 MA	1 5 0
12V	270V 100MA	3 15 0
12V	500V 350MA	8 10 0
12V	1200V 200MA	6 10 0
6V	500V 150MA	6 10 0

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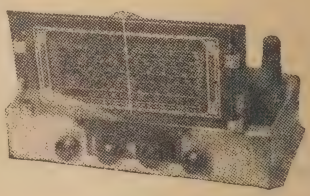

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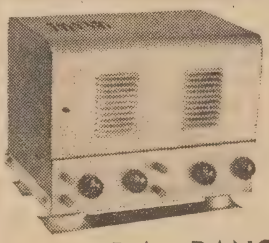

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Universal 240V AC & 6V or 12V as required.

5 VALVE **£32/12/6**
6 VALVE **£36/17/6**

PROBES FOR YOUR VT VOLTMETER

(Continued from Page 69)

Neglecting the dielectric losses the uivalent input resistance of a unt diode probe is considerably ver than the value of the load re- tor. Where the load for both AC d DC is a single resistor it can shown to be approx. the value of load resistance divided by 3. However, in the case of the crystal obe the input is further shunted the back resistance of the diode.

It should be noted that these loading and frequency effects are not peculiar to the R TV & H instrument, despite claims regarding some commercial instruments.

ORE ON LOADING

The subject of loading is discuss- l in some detail by M. G. Scrog- in the Radio Laboratory Hand- ok 6th Ed.

Articles worth referring to, by same author, appear in 'Wire- s World, March, 1952, and June d July, 1954. For those who are in- ested in a quantitative treatment the behavior of vacuum tube ltmeters, particularly their re- onse to pulses, the article in ectronic Measurements by Ter- n and Petit 2nd Ed. may be of lue.

In conclusion a discussion of some ecific cases of the loading effects the probes will help readers to them to the best advantage.

We have reproduced here a trac- from the screen of a CRO gure 4) which gives some indi- ion of the loading of the 6AL5 de probe when connected across circuit with an internal impe- nce of 1 megohm. The dotted ve indicates the waveform thout the probe and the solid ve the waveform with the obe connected.

The two curves were obtained nultaneously by means of a vi- atory switch which was used to nect the probe across the cir- it for about half the average ive time of the sweep. The ex- rimental layout would have rsened the case for the probe ce the shunt capacitance of the itch to earth was added to that the probe but at the frequency ed, 5 Kc/s, the diagram does ve some indication of the order the loading.

TREME CASE

The special feature worthy of te is the clipping of the posi- e half cycle during the period e diode conducts.

This is a fairly extreme case. typical audio voltage ampli- r would have a plate load re- tor of 0.25 megohm. This is nted by the grid return resistor the following valve and the remental plate resistance of the ltage amplifier.

If you take typical values you ll find that the effective internal istance of circuit is of the order 0.15 to 0.2 megohms. The 6AL5 de probe can therefore be used give a reasonable indication of ltage level and gain in the case circuits of this type bearing in nd that the voltage level and hence the rate of discharge of the coupling capacitor is fairly small.

Although the resistive component of the input admittance of the crystal probe is smaller than that of the 6AL5, it must be remembered that this is only one of two loading factors.

If you go to the trouble of calculating the input admittance of the probes, say from the experimental figures we have already given, it will be found that the loading of the crystal probe is less in the video and radio frequency ranges. Of course, the maximum voltage which can be measured is limited by the characteristics of the crystal.

Although the high stability carbon types were listed separately in last month's VTMK parts list, some were of the same value as the ordinary carbon types so that readers may not be sure where a high stability resistor is required.

There were only eight ordinary types and these are easily identified.

RESISTERS FOR TV VOLTMETER

The two 4.7 meg. resistors in the grids of the 12AU7 (V3 & V4) are simply filters and need not be especially accurate. The three resistors associated with S1b are ordinary carbon types while the 100 ohm resistor in the S1d circuit is in series with much larger values so that a large pc change results in a small overall pc change. The 10 ohm resistor shown in the circuit at the top of the S1c network will be a wire wound type, selected or adjusted for the correct value.

The 4.7meg. resistor in the plate circuit of V5 was originally an ordinary carbon type, but after further consideration we feel that a high stability type is desirable. The parts list should be amended, therefore, to read three each of 4.7 meg high stability and ordinary carbon resistors.

PROBING THE EARTH'S MYSTERIES

(Continued from Page 19)

which it is intended to launch during the period. In fact this section of the program may prove to be the most valuable of all, because a satellite will be furnished with all types of equipment for relaying to earth information dealing with all aspects mentioned in this article.

For all the investigations named, observers will be stationed on high mountains, on remote islands never before set foot on by man.

Scientists will settle in the remote wastes of deserts and icy wastes of the polar regions. All observers will be equipped with means of radio communication and be in touch with each other so that simultaneous observations may be made of any particular phenomena under extremely varying conditions.

This Geophysical Year can have far-reaching effects on our way of life. It is refreshing to at last see some concerted effort being made by scientists to aid us in our fight for survival, instead of being directed toward our destruction.

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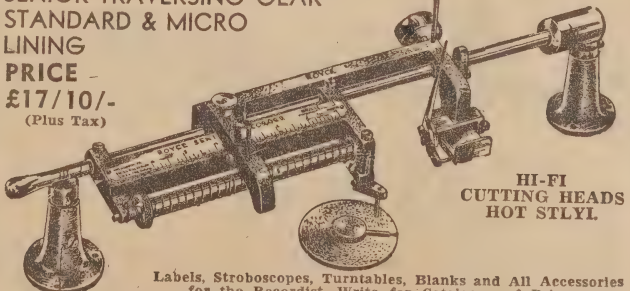
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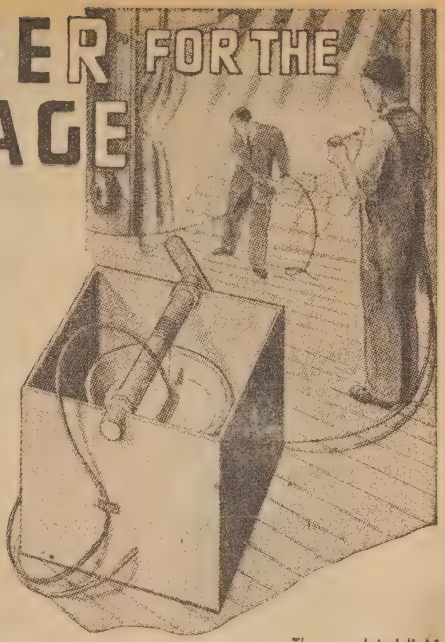
A LIGHT DIMMER FOR THE AMATEUR STAGE



The completed light dimmer.

Stage lighting for amateur dramatics or concerts is never really complete without some arrangement for dimming and intensifying the illumination slowly. Certain effects are entirely dependent on a protracted "fade out," and even the putting on of the lights to start with and cutting out at intervals, etc., is improved by "rheostat" action. This article describes how it may be accomplished by the handy man.

HERE are several methods by which a progressive increase or crease in the flow of an electric rrent can be produced, but for amateur stage electrician the quid resistance" as described here d shown in Fig. 1 is without ubt the simplest.

The principle is that when a current is passed through a vessel conning water to which common salt soda has been added varying restances come about in proportion the distance through the solution current has to make its way to se the circuit.

The cross-sectional diagram (Fig. shows the general arrangement rent is running straight through. The best results here are obtained when the triangle is cut so that when the lower point is on the bottom the upper corners also contact the sides of the pail. This is simply a matter of cutting the triangle to suit the particular size and shape of pail being used.

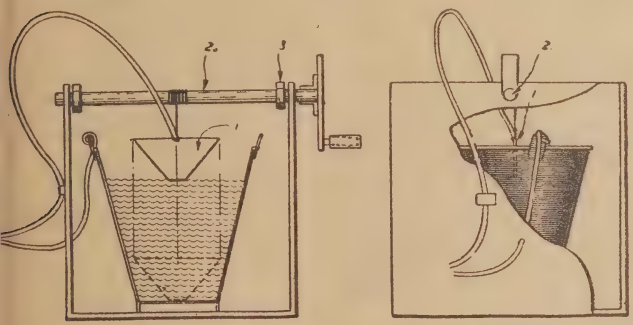


Fig. 2: Two views showing the general arrangement of the dimmer.

the "dimmer"—the official name this apparatus, though it is also d for entirely opposite action. As d out it is capable of dealing th currents up to 5 amps.

An ordinary domestic metal pail, possible of fairly steel sides, is d. The triangle of fairly thick plate, marked "1" in Fig. 2, is de by folding a diamond shape oss its smaller axis and with its ver points ("a" in Fig. 3) turned ward. The box used is about size of a tea-chest and this is keep everyone away from any- ng "live" including, of course, the tal pail itself.

tem "2" is a spindle by means which the triangle is raised and vered in the pail, which latter ds the resistance-varying solun. The spindle runs in the reses cut out of the upper edge the box.

When the foot of the triangle is the bottom of the pail the current is running straight through. The best results here are obtained when the triangle is cut so that when the lower point is on the bottom the upper corners also contact the sides of the pail. This is simply a matter of cutting the triangle to suit the particular size and shape of pail being used.

The spindle "2" may be made from a piece of discarded broom handle. The two recesses for it are taken out from opposite top edges of the box. To prevent the spindle slipping sideways and so out of the hollows two wooden washers ("3" in Fig. 2) are fitted. They are made as shown in Fig. 3, located just inside the box, and are fastened to the rod by a nail or screw carefully inserted and revolving with it. Cut the washers first as a square and then trim the corners as shown.

At one end of the rod is the simple crossbar and handle (held by small angles) to facilitate easy and smooth turning.

ASSEMBLY

Place the pail in the box. Break one of the electric leads to the footlights or whatever lamps are to be controlled and take the loose end of one side of the break through a hole in the side of the box. Attach this cable firmly to one of the handle loops on the top edge of the pail. Strip the cable end for a few inches and wind the bare wire around the metal loop, tightening up with pliers. A bolt through the metal would make a better terminal.

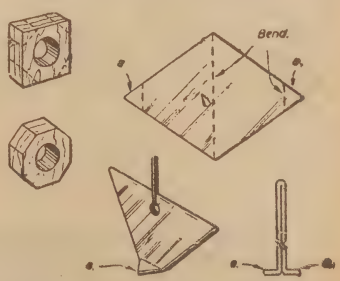
If dealing with DC electric supply the negative line should be broken for the dimmer.

Now set the spindle in the hollows, see that it rotates easily, and from it suspend, with thin cord, the triangle of tinplate.

Next take the other end of the cable and attach this firmly to the top of the triangle, as shown in Figs. 1 and 2.

The cord must be fixed securely to the spindle with a few tacks at its end and wrapped around several times so that the raising and lowering of the tinplate is positive in action.

The cable attached to the triangle must come down easily with it and



Construction of the tin-plate triangle and the wooden washers.

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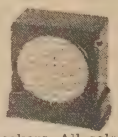
CHIEFTAIN EXTENSION SPEAKERS



Chieftain Extension Speakers. All colors available—Cream, Blue, Green, Grey, Walnut, Burgundy, with 3 inch speaker fitted.

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Record Storage Cabinet. Size 2ft 7in high, x 1ft 6in wide, 14½in deep, finished in Walnut Veneers, 2 shelves.
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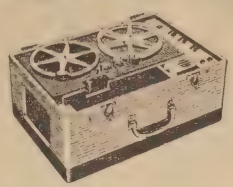

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uld stand in an easy curve above
edge of the box, as shown in Fig.
This is effected by fastening the
le to the side of the box with a
ther strip (a piece of old strap
ll do). The leather holds the
le, which should be of the heavy
e (not untwisted flex) in a light
tion grip, and it can be pulled
and down till the right amount
slack in the loop is secured and
d. There must be no dragging
the lead over the edge of the box.
inally, fill the pail with a saline
soda solution. First nearly fill
h clear water and lower the tri-
gle to the bottom. Switch on,
if all is in order the lights in
circuit will burn to their full
ensity. Rotate the spindle, so
wing up the triangle, and the
its will go out. Raise till the
nt of the tinplate is just in the
uid, as shown in Fig. 2.

Now slowly add a concentrated
ution of salt or soda, switching
as it is stirred in, and then
tching on to see the result.

The salt or soda solution has the
ct of reducing the resistance of
water and must be added until
is found by trial that, with the
ngle still at the top position and
h its point just immersed, the
ps start to glow very faintly.
s is the degree of concentration
ded.

Lowering the triangle, it will now
found, causes the bulbs to burn
re brightly in proportion to the
a immersed and the distance it
rom the pail. When the metal is
last contacted, the lamps burn
in at their old intensity.

URANIUM IS A NEW SOURCE OF POWER

(Continued from page 11)

mordants in dyeing and in calico-printing. They are also used in making certain types of pottery and glass. The black oxide is employed to produce the rich velvety black color on porcelain and sometimes on glass. Uranyl red and uranyl yellow are also used in similar applications, giving respectively an orange or a yellow color. When the uranyl yellow is used in the process of making glass a highly fluorescent glass is the result. Such a glass glows brightly with a greenish-yellow light under dark illumination—that is by the light from an electric lamp that has been shielded by several thicknesses of deep blue glass, so that little or no visible light appears. The same effect is produced in daylight and the effect is so intense that in bright daylight the glass appears to be self-luminous.

FLUORESCENT QUALITIES

Many of the uranium ores exhibit fluorescence, though pitchblende is not one of them. In prospecting for uranium it would be possible to employ an ultraviolet lamp in order to locate the fluorescent material, but of course all the primary ores would probably be missed. And the position is still further complicated by the fact that tungsten and certain other minerals also fluoresce in blue light. Fortunately other methods exist for identifying uranium. In addition to the Geiger-Muller counter and other electronic instruments, there is a simple way of estimating the occurrence of radioactive materials by the use of a photographic film. This is placed next to the ore specimen and left in place for a week or so, all other light being excluded. All radioactive materials affect a photographic film and so provide evidence of their presence. Such self photographs are called autoradiographs. Because there is no attempt at focusing, the uranium grains nearly always produce a "blur" which is larger than the actual grains. This exaggeration has to be taken into account when assessing the amount of uranium present.

Uranium and all its compounds are radioactive, and they are all poisonous. Hence great care must be exercised in handling the metal or its compounds, and precautions have to be taken against breathing the dust that may arise in the use of these materials. The latter precautions are of course specially important in mining the ores.

EARLY ASSOCIATION

For most people, uranium came to be known through its use in atomic bombs and in the production of vast quantities of energy in atomic piles. It is more than likely that this latter use may in the future account for nearly all the uranium produced. Had it not possessed a fissionable isotope it is clear that its other uses are not unimportant, and some of them would certainly have been exploited more than they have been to date.

A READER BUILT IT

(Continued from page 73)

The construction of the speaker inet is shown in the diagrams. top is of ¼in timber, the bottom 1in and the front and back are three-ply.

The speaker cabinet is made to mp on the horizontal section of angle bar that runs from the nt fork of the cycle to the handle-s.

The bottom of the speaker cabinet grooved 5-16in deep and 3-8in ius to take the horizontal bar. similar groove is cut into a piece timber ¾in x ¾in x 3in to act the other part of the clamp (see grams).

The main receiver cabinet is ened to the cycle by strapping o a standard cycle carrier. The nection between the two units is de with two-core flex fitted with plug at one end.

To protect the receiver from d shocks a piece of ¼in thick nge rubber is used between the eiver and the cycle carrier. Also shafts of the variable condensers e tightened a bit to prevent ration of the setting when a np is hit.

Our contributor reports very d results with this receiver and idea will no doubt appeal to a nber of our cycling enthusiast ders.

HOW TO DESIGN GOOD ANTENNAS FOR SAILING CRAFT

(Continued from Page 25)

area of the feed conductor in the monopole system through the addition of wires in a fan or cage configuration, the feed-point impedance can usually be reduced to a level which can be accommodated by the transmitter output circuit. In transmitters having extremely limited accommodation a simple L net may be used for impedance matching.

Any antenna system is likely to pick up electrical noise generated aboard. Not only does the auxiliary-engine ignition system and electrical equipment act as noise sources but any variable contacts aloft or below deck do also. Engine and motor noise can be eliminated by the usual means but special treatment is often required to reduce contact noise. In one case noise was thought to come from the engine, since the receiver rattles had the same period as the firing of the engine cylinders. Electrically silencing the engine showed that the interference was coming from variable contacts aloft which were rattling from the engine's vibration.

Conditions such as this can also affect transmission, so chance contacts should be minimised with any antenna system either by isolating the elements, insulating them or incorporating them into the system by bonding. Noise is also generated by electrolytic and static currents below deck.

Important installations should be worked out on a scale model. So many unknowns and variables are found aboard sailboats that it is virtually impossible otherwise to prepare accurate plans or predict operation.

A simple wire model, having the main rigging features and using a frequency to scale, will show the best layout, the feed impedance, radiation pattern and efficiency. Measurements which compare acceptably with those aboard ship can be made on a rigging model built over several feet of screening laid in any clear space.—(Electronics)

A COURSE IN TELEVISION

(Continued from Page 93)

What does appear, however, is a variety of other detail drawings which show the permissible tolerances in the "shape" of the various synch. pulses—in other words, the change in voltage plotted against time. Fortunately, perhaps, these are the concern of station engineers.

Such then is the nature of the signals radiated by each and every television station—one for sight and the other for sound—each conforming to a strict set of Standards.

Having regard to the number of factors which these Standards must fix, it will be obvious to the reader just how vital they are; why receivers built to satisfy one set of Standards cannot simply be transhipped to another continent to receive signals of a different character.

(To be continued)

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ANSWERS TO CORRESPONDENTS

P.N. (Glen Oak, NSW) sends two
s' subscription to the magazine and
resses his appreciation of articles
ished, particularly the "Service-
" series. He suggests that the Ser-
man should produce a trouble-find-
chart covering the more common
ver defects. A Telefunken receiver
h he possesses has a faulty speaker
he would like to know where he
d have it repaired and also where
ould obtain a circuit of the receiver.

: Your subscription has been for-
ied to the appropriate department
., and you should have received
official receipt by the time this
ars in print. Many thanks for your
remarks and we will pass these and
suggestion on to the Serviceman. We
rstand that both AWA, 47 York St.,
ney, and Fred A. Falk, King St.,
dale, are agents for Telefunken and
r may be able to help you. Alter-
ely you may care to contact the
ers direct, at least regarding the
lit, one address being Telefunken,
ie Lamennais, Paris, France.

N. (Ryde, NSW) writes to us and
if we could print an under-chassis
ng diagram of the 4 Valve Karset.
do we intend to design a composite
nstrument powered from a common
sformer.

: We were pleased to receive your
estions but we could not possibly
rtake now to produce a wiring dia-
n for the Karset. In general, most
tructors are able to follow the coded
graphs and the great deal of time
h is necessary to prepare a wiring
am for every unit we build is
d. With regard to a composite in-
nent, we have serious reservations
t this approach. For example, not
eaders may want to construct the
cular combination of instruments
perhaps we would select. Then
, feeding more than one instru-
: from a common power supply is
e to introduce interaction between
instruments which may be very dif-
: for our readers to track down.
question of cost also arises, for
e a reader may be able to build
small instrument now and another
few months' time, it is unlikely
he will want to pay up for one
complex instrument at the one

C.G. (Grafton, NSW) has a 32-volt
ver which he wants to convert for
volt AC operation.

: Without exact details of the circuit
can only advise you in a general
The change-over could be effected
rewiring the filament circuit to the
usual parallel arrangement and
tituting a conventional AC power
ly for the vibrator supply. You
d probably need a 285-volt 60 or
A power transformer, a filter choke
milar rating, a 5Y3 rectifier and the
electrolytic filter capacitors. We
probably let you have a circuit
aining a typical power supply if you
to use our postal query service.

W.G. (Oolbun, Q.) is under the im-
sion that we have described a ger-
um crystal set using two crystals
which would operate a loudspeaker.

: It seems likely that you are con-
g the germanium crystals with tran-
s. R.W.G., possibly because they
oth based on the use of germanium.
ever, the action of the two is quite
rent and the transistor is able to
ify and, with limitations, perform
y of the functions of a valve. It is
more efficient, bringing closer the
when battery sets will require only
action of the amount of power they
at present. A series of construc-
l articles on transistor sets com-
ed in the May issue and a two-
resistor set appeared in the June
. We suggest that this is the one
had in mind but we must point out
the performance on a loudspeaker
distinctly limited, even though the
e unit was more efficient than any-
thing we have previously encountered. Once again, we emphasise that these devices are purely experimental and that we will have to wait for better transistors before really practical circuits become a reality.

A.M. (Berri, SA) is a constant reader of our magazine who is becoming increasingly interested in the "why" and the "wherefore" of radio. He suggests we run another beginners' course similar to those we have conducted in the past.

A. Many thanks for your comments and suggestions, A.M., and we may be able to do something along the lines you suggest in the not too distant future. Meantime we suggest you study the various constructional articles, "Answer Tom", &c., which often contain important basic principles.

L.J.B. (East Malvern, Vic.) is a young reader who is commencing to take a keen interest in radio and wants to know where he can learn "all about it".

A. Your suggestion to start with crystal sets and progress to larger sets is a sound one, L.J.B., and we have published several series of articles in the past designed to guide the beginner along these lines. Unfortunately, these issues are no longer available, though we have copies of all the circuits which are available through the postal query service.

A.C. (Caulfield, Vic.) wants to know if it would be possible to use a crystal or other type of microphone with the Playmaster Crystal Control Unit (November, 1955) also the issue in which the twin speaker networks appeared.

A. Rather than try to modify the control unit for a microphone, it would probably be better to provide a separate preamplifier for this purpose. Such an amplifier was described in the January, 1955, issue and copies of the circuit are available through the postal service.

The twin speaker networks were described in the October, 1955, issue.

E.S. (Prospect, SA) wants to build a portable transistor set having good performance in all respects and operating from a rod aerial. He suggests that a 67.5 volt battery may be modified to deliver 22.5 volts and that this may serve as a basis for the design.

A. Sorry, E.S., but if it was as easy as you seem to imagine we would have described such a set before this. The recent series of articles on transistors and transistor set explained the situation in some detail and we are afraid that the picture has not changed greatly since then. Briefly, it is to the effect that there are not many transistors available in this country which are suitable for use at radio or intermediate frequencies. This means that it is difficult to build a set having a reasonable sensitivity compared with conventional sets. There is also a complete absence of coils, IF transformers, &c., to suit transistors and this is likely to continue until suitable transistors are available in quantity. All things considered, we think you would be unwise to pursue this approach at the present time since it is unlikely that you would achieve satisfactory results.

P.W.G. (Cammeray, NSW) sends a subscription for the following twelve months and expresses his appreciation of the scientific articles appearing in the magazine. These appear to have tied in with recent school work.

A. Many thanks for the subscription, P.W.G., and an official receipt should have reached you before this appears in print. We are glad to learn that the articles are of such interest to you and trust they will continue to prove useful. Many thanks also for your comment regarding the parrot ashtray. This was a reprint article and we have had no opportunity to try it ourselves. Your experience may prove useful in the event of further queries. The important point about the device is that it should cease to oscillate when the hand approaches the metal plate, the failure of oscillation providing the change in plate current. We feel that this is not happening in your case and it may be advisable to try for a setting which provides less vigorous oscillation thus allowing it to drop out more readily as the grid circuit is detuned.

L.J.S. (Hobart, Tas.) would like to see a new edition of the Short Wave Handbook, as he is a very keen S/W listener.

The Radio, Television and Hobbies Query Service

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For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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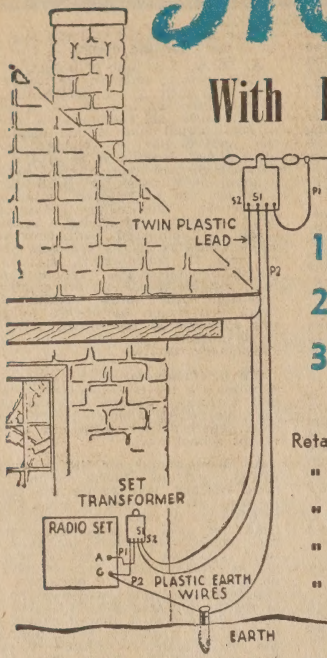

MAKE THIS SIMPLE TEST:—

1. Remove aerial from set. If the noise stops, you need an AF21C aerial filter, as the noise is coming through your aerial.
2. If the noise continues, you need an LF20 line filter as the noise is coming through your power main.
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"	LF20 line filter ..	37/-
"	LF20C " " ...	42/-
"	LF24 " "	50/-
"	LF24C " "	55/-

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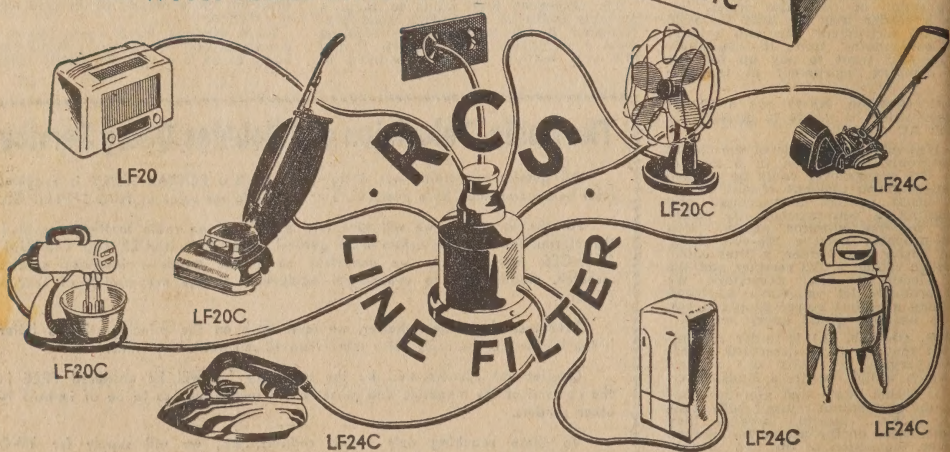

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In spite of staff shortages we have ged to publish a larger magazine ent months. In doing so, however, ave very little time left to consider projects, such as the handbook, fore, this will have to wait until able circumstances allow its pub- on.

S. (Auburn, NSW), a reader of 10 years' standing, writes to say there has been an improvement in , TV and Hobbies recently. He particularly to the November issue.

Our thanks indeed. With many of eaders becoming more sophisticated radio and electronics articles on a r technical level will be appearing frequently. However, there are still who like constructional articles on e receivers, amplifiers, &c., ex- ed in detail, and we must continue clude them, even if it means mak- ne number of pages more than they ow. We agree that modern minia- components with high ratings offer sting possibilities for the future.

. (South Perth, WA) sends a sub- ion for the following 12 months expresses his appreciation of the for the previous 12 months. He sends a circuit of a continuously ble top cut filter which he has built uggest we may be able to use it.

Many thanks for the subscription and we have forwarded this to ppropriate department. You should e an official receipt direct. Many s also for the kind remarks and ill certainly try to keep up the ard. It is likely that your circuit appeal to other experimenters yourself and we are filing it for le use in the Reader Built It page later date.

.D. (Townsville, Qld.) says he has up a push-pull amplifier but has intrigued by recent references to Ultra-Linear circuit. He wants to whether we could give an ex- tion of it in the "Answer Tom" ns.

We probably could N.T.D. We will nly keep your letter by us for e reference.

.W. (Wollongong, NSW) wants to if a 240 volt turntable can be ed for us from a six volt battery if so, how.

It would probably not be a pro- on to modify the motor J.W.W., but y be possible to use some form of ter. If the motor is one of the older C types using a governor for speed ol it would be sufficient to use some of inverter without much regard he frequency involved. This could the form of a vibrator unit (Simple nverter Radio and Hobbies April or a rotary converter of the type y available through disposals es. If the motor is a synchronous it will be necessary to ensure that requency of the power fed to it is s. It may be difficult to ensure ity when working from a gene- but the inverter should be satis- y provided the vibrator is a special designed for 50 cps operation. Most tors are designed for 100 cps but s types are available to special

S. (Annerley, Qld.) is puzzled be- his 1955 "Babygram" squeals when one control is turned to "treble". e same time, he can measure a AC voltage between the "cold" side e capacitor and earth.

The answer is simple enough. When et squeals, the output stage is act- an audio oscillator and the volt- you are measuring is an audio e. It may not be the actual value eter reads because of the frequency that can occur.

. (Geelong West) sends in notific- of a change of address, and also inquiries about a KC4 communic- receiver.

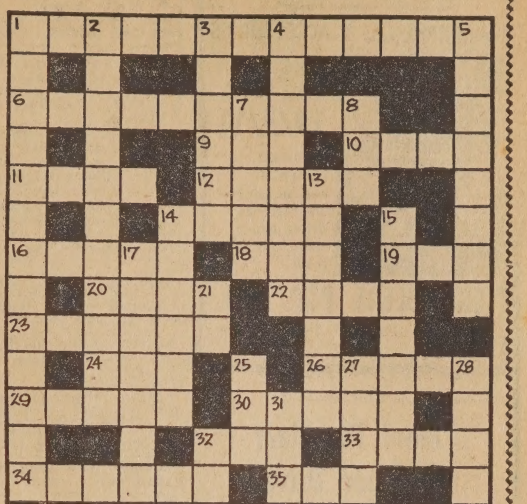
Thank you for your letter, K.C., ave forwarded the notification to appropriate department. However, egret that we are unable to pro- any information on the receiver oned.

. (Oakleigh, Vic.) would like to if it is possible to operate a three ge transistor set from a 9ft car aerial.

THE R. & H. CROSSWORD No. 22

ACROSS

1. Has continuity (2 words)
6. An abrasive (2 words)
9. Mineral
10. Luminous discharges
11. Rooster
12. Navigational system
14. Useful as flux
16. Stanza
18. To corrode
19. Horse (slang)
20. Part of a transformer
22. Length of wire
23. Caught in an obstruction
24. Girl's name
26. Better
29. Valued
30. Anode
32. Yes (Scottish)
33. To prepare a publication
34. Famous inventor
35. Unit of resistance



DOWN

1. Applied to annual residual magnetism (2 words)
2. Has no continuity
3. Centre fed antenna
4. Denoting a standard measure
5. Two in cascade (2 words)
7. Got up
8. Hurried
13. Aerial
14. Read over
15. Persuaded
17. Metallic cement (pl.)
21. Editor (abbrev.)
25. Secret agent
27. Separate unit
28. Ceremonial observance.
31. Sign of the Zodiac
32. One

Solution and further crossword next month

A.: Unless you happen to be in an area of very high signal strength L.D., the transistor receiver is not likely to perform satisfactorily with an aerial only 9ft long, almost directly above ground. Much better results are to be expected if a high aerial of at least 40 to 50 feet length, is used. From the foregoing it will be obvious that the above transistor set is not as yet a proposition as a car radio.

R.P. (Yagoona, NSW) is at present finishing his high-school studies but intends to qualify as a radio amateur as soon as possible. He forwards details of a grid-dip oscillator which he has constructed and points out the advantages of using link coupling between the inductor of the oscillator and the circuit under test.

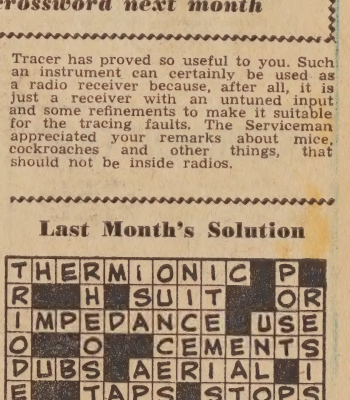
A.: Thank you for your letter and the comments. There is some merit in your suggestion the only difficulty being perhaps that it makes the overall instrument a little more complicated and careful attention would have to be paid to the design of the coils and links for consistent results over all bands. Glad to know you like the Serviceman and we hope that many of the future constructional articles are of interest to you.

M.J (Charleville, Qld.) reports very good results with the "Senior Signal Tracer" and he states that it also works very efficiently as a long-range receiver.

He also expresses his appreciation for the magazine in general.

A.: We are very glad to hear that you like our magazine, and that the Signal Tracer has proved so useful to you. Such an instrument can certainly be used as a radio receiver because, after all, it is just a receiver with an untuned input and some refinements to make it suitable for the tracing faults. The Serviceman appreciated your remarks about mice, cockroaches and other things, that should not be inside radios.

Last Month's Solution



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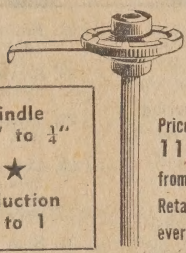

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FOR SALE: Brand New Collaro Transcr. Player 2010, £24. Philips D.W. Ampl., £21. Rola 12.0 Speaker with Transf., £4/15/-. **JB3744, Sydney.**

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SELL: Leak Pickups, one L.P., one 78. Diamond styli. Transformer, £20. **XM3712.**

SELL: VHF TX with rack 5ft, £5; 3BZ TX, £4; 101 TXRX new £5; 82-9B, new, £3; push button, 2 gangs, £1; new Strom. Carls. 3 speed Player, £12; 150 VHF Aerials, £5 lot; 2 "L" and 4 "F" Phones £3 ea. **1 Darley Rd., Randwick, Sydney.**

SELL: Radio mechanic selling private bits and pieces before going overseas. Approximately £100 worth of radio equipment, some new. Any interested person write **J. Kenney, Caltowie, S.A.**

FOR SALE: All back issues of R. & H. for sale. Several copies of each issue in stock. All types of constructional articles are in numbers. Inquiries welcome, 4/- per copy posted. **T. Weir, 73 Gibson Av., Padstow.**

SELL: Ham completely selling out—Eddystone 640 receiver, fine condition; partly-built TX, freq. meter, 300v power pack, transformer chasses, etc., and host of TX and RX components. £70. **52 Blackwood St., Carnegie, Melbourne.**

WANTED: R. & H., Nov.-Dec., Mar., 1952; Mar., 1953. Please **UY8056, Sydney.**

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SELL: Playmaster Amplifier No. 5, ode Output with Control Unit, or No. 6. Low price. Control Unit £12/10/- post free registered. **J.W Exhibition St., Melbourne.**

ANSWERS TO CORRESPONDENTS

C.W. (Perth, WA) submits a number of circuits which have been incorporated in various Radio and Hobbies projects in past years and wants to know why we don't still use them. He also wants to know why we don't use the 6V4 in preference to the 6X4, since he claims that the former is a better valve.

A.: The first of your circuits is one of the early feedback circuits requiring the use of three resistors. The same job can be done using only one resistor from plate to plate. Since it is simpler and cheaper there seems little point in using the older scheme. The second scheme is still regarded as a good one if one requires treble boost, but we have had little occasion to use it recently. The third circuit derives the drive for the second valve in a push-pull system from the screen of the first valve. This is also still a good idea except that it is only suitable for use with class "A" conditions. With class "AB" conditions the signal in the screen circuit is distorted before being fed to the second valve. This will also distort it and the result is useless. The fourth circuit is that of a high gain phase splitter such as was used in the 6-240 amplifier for February 1949. This idea is good in certain specific applications, the gain coming from the previous pentode driver stage rather than the phase splitter. By feeding signal to the lower end of the plate load resistor the plate load can be made to appear many times greater than the resistor value and the gain of the valve increases accordingly. It is this high gain which is one problem of the circuit as well as an advantage. It is often difficult to find a potentiometer which is quiet enough to be used ahead of the high gain valve. Also, while it may have enough gain for use with a crystal microphone, the largest pot. normally available is too small for best operation of the microphone. Finally, the very impedance of the plate circuit rend liable to shunt loading effects and of treble response. As to whethe 6V4 is better than the 6X5, this is a matter of application. Within limits of 70 mA drain there is lit choose between them, and most come within this figure. The mai vantage of the 6V4 would appear that it is rated to 90 mA, but this little real value in small sets.

E.M. (Albury, NSW) writes to Serviceman to tell yet another sto a butchered speaker, this time by of its manner of connection to the

A.: Many thanks for your letter and we will pass your letter on t Serviceman for his possible com In the meantime, any further con on our part would only spoil the s

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